

DOCUMENT RESUME

ED 149 620

FL 009 207

AUTHOR Korn, Caroline A.
TITLE Teaching Language through Science in a Primary Bilingual Classroom.
PUB DATE Aug 77
NOTE 126p.; Master's Thesis, University of San Francisco
EDRS PRICE MF-\$0.63 HC-\$7.35 Plus Postage.
DESCRIPTORS *Achievement Gains; *Bilingual Education; Bilingual Students; Criterion Referenced Tests; English (Second Language); Interaction; *Language Development; *Language Instruction; Language Proficiency; Language Skills; Language Tests; Primary Education; *Science Instruction; Science Units; Second Language Learning; Spanish; *Teaching Methods; Test Results
IDENTIFIERS California Test of Basic Skills

ABSTRACT

The purpose of this study was to develop and test the effectiveness of a program in which activity-based science was used as a conceptual basis for language instruction. A series of four instructional units were adapted for bilingual use. Students' written and oral observations were used in experience charts and other language development activities. In this study two bilingual second grades were compared. The comparison group was taught language and science separately in a traditional manner. Both classes were tested using the California Test of Basic Skills (CTBS) language test and a criterion-referenced test of written language. Among the conclusions were: (1) Students in the treatment group made statistically significant gains in all three areas of the CTBS language test. The comparison group made significant gains in two areas, spelling and language mechanics, but not in expression. (2) On the criterion-referenced test, the treatment group exhibited higher gains than the comparison group. (3) An increase in class interaction between students of different language abilities was noted.
(Author/CFM)

* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *

ED149620

TEACHING LANGUAGE THROUGH SCIENCE IN
A PRIMARY BILINGUAL CLASSROOM

A Project/Thesis presented to the
Faculty of the School of Education
University of San Francisco

in partial fulfillment of the requirements
for the degree of Master of Arts

in Elementary Education

BY

Caroline A. Korn

August 1, 1977

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

"PERMISSION TO REPRODUCE THIS
MATERIAL HAS BEEN GRANTED BY

Caroline A. Korn

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC) AND
USERS OF THE ERIC SYSTEM."

2

This project/thesis, written by

Caroline A. Korn

August 1, 1977

Under the guidance of the Project/
Thesis Committee, and approved by
all its members, has been accepted
in partial fulfillment of the re-
quirements for the degree of

MASTER OF ARTS

in

Elementary Education

Dean, Graduate Division

Project/Thesis Committee:

Albert Wifon
Chairperson

Wm. V. Burgess

S. Carol Marie Kelly

July 19, 1977
Date

VITA AUCTORIS

Name: Caroline A. Korp

Date of Birth: October 18, 1939

High School: Merced Union High School

Graduated: 1957

Baccalaureate Degree: 1963

College: California State University, Fresno

Date: August, 1977

DEDICATION

This thesis is dedicated to my husband, Alex
whose interest, support, and suggestions have contributed
so much to the preparation of this study.

ACKNOWLEDGEMENTS

An expression of sincere appreciation is made to Nicholas D. Ferrero, Principal of the Sunnyslope Elementary School whose leadership encourages innovation and experimentation in an effort to improve education.

Acknowledgement is also given to Sister Carole Marie Kelly, Director of the Hollister Elementary School District Bilingual Program, for her encouragement and assistance throughout this study.

Sincere appreciation is extended to Al Dixon and Rosemary Faitos whose ability and humor made this an enjoyable experience.

TABLE OF CONTENTS

	<u>Page</u>
<u>Vita Auctoris</u>	iii
Dedication	iv
Acknowledgements	v
List of Tables	vii
List of Appendices	viii
Chapter 1: Proposal.	1
Chapter 2: Review of the Literature.	23
Chapter 3: Presentation of Findings.	60
Chapter 4: Conclusions, Recommendations and Implications of the Study	79
Appendix	86
Bibliography	109

LIST OF TABLES

Table		Page
3.1	Comparison of Characteristics of the Students in the Participating Classrooms	62
3.2	Summary of Evaluative Instruments, Language Utilized, and Number of Students.	67
3.3	Means and T-Values for Oral Language Assessments On First and Fourth Units of Language-Science	71
3.4	Results of Friedman Two-Way Anova Comparing Biweekly Written Assignments for the Treatment Group	72
3.5	Means and T-Values for Comparisons Between Treatment and Comparison Group Scores on CTBS Language Test.	74
3.6	Results of Wilcoxon Matched-Pairs Signed-Ranks Tests Comparing Describe An Animal Scores	76
3.7	Results of Wilcoxon Matched Pairs Signed-Ranks Tests Comparing Picture-Concept Test Scores	77

LIST OF APPENDICES

Appendix A

Picture-Concept Test.	90
Describe An Animal Test	97

Appendix B

Anecdotal Record	99
Written Language Rating Scale	100

Appendix C

Sample Lesson Plans	101
-------------------------------	-----

Chapter 1

PROJECT/THESIS PROPOSAL

PURPOSE

The purpose of this project is to develop a series of instructional units correlating language and science instruction in a bilingual classroom. Each unit will be designed to include language development activities such as vocabulary building, sentence writing, and spelling in the student's dominant language, English or Spanish. The units will also include science process skills of observing, classifying, measuring, and communicating.

The following strategies will be used in each science unit: (1) dual-language science presentation, (2) small group lessons in the students' dominant language, (3) related bilingual learning center activities, (4) vocabulary development, (5) creative writing, and (6) selected stories and poems for listening and discussion.

The researcher will implement four science units in her bilingual second grade classroom. These units were selected from Science-A Process Approach¹ and are titled

1. Observing--Color, Shape, Texture, and Size
2. Classifying--Solids, Liquids, and Gases

1

American Association for the Advancement of Science/XEROX Corporation, Science-A Process Approach, Description of the Program Part C (Lexington, Massachusetts: Ginn, 1974).

3. Measuring--Seeds and Seed Germination

4. Communicating--Stages in Life Cycles

By correlating language development and an activity oriented science program in the classroom, the researcher intends to use the high interest which this method of science instruction can spark in children² to (1) elicit an unselfconscious use of the child's dominant language upon which experience stories and creative writing may be based, (2) encourage free experimentation in the target language, (3) provide opportunities to hear language used in new situations in order to internalize new language patterns, (4) facilitate the acquisition of new vocabulary, (5) strengthen the ability to observe, classify, measure, and communicate information, and (6) develop new concepts in the area of science.

Student progress will be evaluated by using pre- and post-tests of language and science skills. Weekly anecdotal records will be kept. In addition a bilingual comparison group will be given language and science tests and progress of the two groups will be compared.

STATEMENT OF THE PROBLEM

Edythe J. Gaines, Superintendent of the Hartford, Connecticut Public Schools, speaking at the second general

²William K. Esler and Jack Simmons, "Investigating the Attitudes Toward Science Fostered by the Process Approach Program," School Science and Math, 72:4 (April, 1973) pp. 291-318.

session of the National Science Teachers' Association, said that due to the movement back to the basics "children are being led into an impoverished curriculum, one which is especially detrimental to the children of the poor and the powerless who most deserve richness...I wish to stress the important role science can play in refining children's thinking powers, ...observing, classifying, interpreting, generalizing..."³

Children can encounter in science one of their most satisfying and valuable school experiences particularly when teaching methods encourage learning by doing. Children can benefit from the study of science in ways that can be of special value to students for whom English is a second language. Jerry B. and Mary N. Ayers report that "children involved in action based science courses make considerable language gains, even scoring higher in standardized reading tests than non-science peers."⁴

Language development needs a subject; something to talk about. Terms relating to description, comparison, and part-whole relationships are common to both language development and science at the primary level. In many ways science

³Edythe J. Gaines, "Do We Owe Children Science As Part of the Basics?" Science Teacher, 43, (May 1976), p. 28.

⁴Jerry B. Ayers and Mary N. Ayers, "Influence of S-APA of Kindergarten Children's Use of Logic in Problem Solving", School Science and Mathematics, 73, pp. 768-71.

can provide a subject for discussion and give practice in talking and writing. Older students also receive dual benefits from a systematic activity based science program. In a study involving sixth graders, as their ability to hypothesize developed, the syntactic complexity of their writing also showed marked improvement.⁵

NEED FOR THE STUDY

The researcher became interested in teaching language through science while teaching junior high and elementary grades in the Hollister School District. Laboratory science was a popular subject. However, a high percentage of students had difficulty reading the science text books and understanding concepts. Many of those students who had difficulty spoke English as a second language and needed additional language development.

When the district initiated its bilingual program in 1974, the researcher had the opportunity to participate. This provided a chance to work with primary grade students in a situation in which learning takes place in the language the student knows best. A sequential program of English as a second language provides more thorough understanding and facilitates later learning of subject matter in either language.

⁵ Mary Ellen Quinn and Carolyn Kessler, "Relationship Between Science Education and Language Development", a 24 page paper presented to the Annual Meeting of the American Educational Research Association, 1976, (U.S. Educational Resource Information Center, ERIC Document ED 123-112.)

Bilingual education provides quality instruction for children who speak no English or whose English is limited. Project Salven Los Niños, proposal of the Title VII program in the Hollister School District points out that "there are three times as many Spanish surnamed students in the lowest quartile as 'Anglo' students."⁶ These figures refer to scores on the reading section of the California Test of Basic Skills (CTBS). The proposal also mentions a high drop-out rate at the San Benito Joint Union High School. "...13.1 percent were non-Spanish surnamed students as compared with 36.1 percent of students with Spanish surnames."⁷ Teachers in the Hollister bilingual program are concerned with helping students bridge the present gap in classroom achievement and in standardized achievement test scores.

Correlating language and science is a means of teaching language in a context of special interest to the student. The researcher plans to implement and evaluate a series of units in which the most effective techniques of bilingual language teaching will be used while also implementing a sequential process approach science program.

⁶Salven Los Niños, Title VII Project Proposal, Hollister Elementary School District, California, 1975, p. 21.

⁷Ibid.

DESCRIPTION OF PROJECT

Name of Project

Teaching Language Through Science in a Primary Bilingual Classroom.

Location

The location of this project is the researcher's bilingual second grade classroom at Sunnyslope School in the Hollister Elementary School District. All public school children kindergarten through second grade in Hollister attend Sunnyslope School. There are three other elementary schools in the district. Hollister has a population of 8,500 and is the county seat of San Benito County. The economy is based on agriculture and many students in the schools are from families of agricultural laborers, cannery workers, and other occupations based on agriculture. San Benito County has the largest percentage of Mexican-Americans of all California counties. "...64 percent of the students in the Hollister School District are of Mexican-American origin... 45 percent of the elementary students in the district speak limited English."⁸

The bilingual program in the district is now in its second year. There are three bilingual classes at each grade level enrolling a total of 750 students or one in five in the district.

⁸Salven Los Niños, p. 21.

English speaking students are also encouraged to participate in the bilingual program and instruction is provided in Spanish as a Second Language. The ethnic balance in the bilingual program is approximately that of the total school population, with 64 percent of the students being of Mexican descent.⁹ A major goal of the program is to create an atmosphere of cross cultural understanding and appreciation. Placement in the program is by parent request.

Duration

Implementation of the language-science units in the classroom will occur from February 22 through April 29, 1977.

Target Population

The target population consists of the students in the researcher's bilingual second grade class. There are five monolingual speakers of Spanish who did not attend school prior to this year. Five students speak limited English. There are six students who are nearly bilingual, and fourteen who are English dominant. Eleven of the children are active migrants who change schools often as a result of parents' work in agriculture. The Migrant Program provides two aides who each spend 40 minutes working with migrant children in the class each day.

⁹Salven Los Niños, p. 21.

TIME LINE FOR PROJECT/THESIS

The following chart indicates the time by which
the task must be accomplished and by which talent (person).

Time	Task	Talent
February 7	Complete plans for language activities to be used in correlation with the S-APA materials	Researcher
February 7	Complete Picture-Concept tests for the assessment of science concepts	Researcher
February 7	Complete language assessment scales for evaluation of oral and written language in both English and Spanish	Researcher
February 16- February 18	Administer Picture-Concept tests and written language assessment to both treatment and comparison groups	Researcher/ Children
February 22- March 4	Conduct correlated language and science activities using S-APA unit, Observing: Color, Shape, Texture, and Size correlated with teacher developed language materials	Researcher/ Children/ Aides
February 22- April 29	Maintain weekly anecdotal records on student progress	Researcher/ Aides
March 7- March 18	Conduct correlated language and science activities using S-APA unit, classifying: Solid, Liquid, and Gaseous States of Matter correlated with language materials	Researcher/ Children/ Aides

TIME LINE continued

<u>Time</u>	<u>Task</u>	<u>Talent</u>
March 20- April 1	Conduct correlated language and science activities using S-APA unit, Measuring: Seeds and Seed Germination with teacher developed language materials	Researcher/ Children/ Aides
April 11- April 29	Conduct correlated language and science activities using S-APA unit, Communicating: Stages in Life Cycles with teacher developed language materials	Researcher/ Children/ Aides
May 2- May 6	Administer Picture-Concept tests and written language assessment to both treatment and comparison groups	Researcher

OBJECTIVES

OBJECTIVE NUMBER ONE

By February 7, 1977 the researcher will have completed instructional plans and materials to be used in correlation with S-APA science materials for the teaching of four language-science units.

Implementation Activities

To develop and produce science-correlated language materials the researcher will conduct the following activities during the month of January, 1977.

1. Obtain Science-A Process Approach modules and module guides which will be used for each unit.
2. Order additional materials in Spanish which will be used to supplement the program.
3. Plan and develop dual language lessons using slides, flannel board, and other visuals which will be used to introduce concepts.
4. Write and produce supplementary materials in English and Spanish which will be used as content oriented reading material.
5. Develop and prepare learning centers which will reinforce basic concepts to be taught in each unit and to extend insights of more able learners.
6. Devise games which involve all children and encourage cooperation to solve problems related to the unit of study.

7. Plan daily small group lessons to be presented by the researcher and three experienced aides. The lessons will include hands-on science activities by students, reading, vocabulary, development, discussion, and writing.

Evaluation Activities

Existence of a detailed plan and collection of materials for the language activities to be correlated with S-APA science units to be completed by February 7.

OBJECTIVE NUMBER TWO

By February 7, 1977 the researcher will select and develop evaluation instruments to be used to assess progress in language skills and science concepts. Children are to be evaluated on their progress in the language by which they learn best, whether English or Spanish. Tests will be selected and developed which can be administered to treatment and comparison groups in limited classroom time. The comparison group will be composed of students in a bilingual second grade class in the same school as the treatment group. The comparison group will be taught language and science by traditional methods.

Implementation Activities

To complete the selection and development of evaluation instruments in language and science, the researcher will conduct the following activities during December, 1976 and January 1977.

1. Determine whether the California Test of Basic Skills, (CTBS) language section may be useful as a means of standardizing results.
2. Plan and develop a Picture-Concept test based on the content of the four S-APA science units to be included in the program. This test is to be administered to both treatment and comparison groups as pre- and post-tests. Tests will be administered in English to English dominant students and in Spanish to those who are Spanish dominant.
3. Plan and develop a test of language skills to be administered bilingually to students in the treatment and comparison groups. In this test students will be asked to describe an animal which is brought into the classroom. Students may write in either Spanish or English. Separate scores will be assigned for concepts and mechanics. Students who are unable to write will be scored on concepts dictated to the examiner but not on mechanics.
4. Develop and field test a scale for written and oral language assessment in English and Spanish. This scale is to be used in evaluating the Describe An Animal test and for evaluating weekly written and oral assignments.

Evaluation Activities

Existence of evaluation instruments in language and science, and existence of a scale for written and oral language assessment to be completed by February 7.

OBJECTIVE NUMBER THREE

Between January 10 and March 25 the researcher will implement a program of training for the bilingual classroom aide and two Migrant Program aides who will assist with the language-science units.

Implementation Activities

To implement training of the three aides in the limited time their schedules allow for planning, the researcher will conduct the following activities from January 10 through March 25.

1. Develop and produce instructional plans for use by the aides in working with their groups during each unit.
2. Conduct a series of short inservice meetings on the following topics:
 - A. Assisting with administration of pre- and post-tests; oral directions in Spanish; proctering.
 - B. Conducting oral assessment using anecdotal record forms.
 - C. Presenting Spanish language section of dual language lessons.
 - D. Developing vocabulary by using "word collection" cards for each child.

- E. Assisting students as they participate in the science process activities of each unit observing, classifying, measuring, and communicating through written statements and graphs.
 - F. Presenting small group reading lessons dealing with unit topics.
3. Maintain continuous communication with the aides regarding their questions, inservice needs, observations, and suggestions.

Evaluation Activities

Existence of a series of instructional plans for use at aide inservice meetings completed between January 10 and March 25.

OBJECTIVE NUMBER FOUR

Beginning on February 22, 1977 through April 29, 1977 the researcher will implement in her second grade bilingual classroom four instructional units in which language development is correlated with science instruction.

Implementation Activities

To implement the correlated language and science units in her classroom the researcher will conduct the following activities from February through April, 1977.

- 1. An existing classroom science center will be augmented and organized to facilitate use for language as well as science instruction.

2. Parents will be informed of the program during conferences and through a classroom newsletter.
3. Students will interact together at learning centers where they will experience the processes of science by working with them.
4. Students will work in small groups discussing their learning center activities, writing about them, and reading experience charts, stories, and related books.
5. Students will participate in dual language lessons designed to review and extend concepts already presented during small group activity. A short presentation is made in Spanish using many visuals to aid comprehension. Later, a similar presentation is made in English.
6. Weekly anecdotal record forms will be maintained recording observations of researcher and aides for purposes of continuous assessment and program evaluation. These records are of particular importance for evaluation of children who have not yet learned to read and write.
7. Students will collect new words they encounter during the science units. These words will become a fund of sight words written on cards to practice with a partner and to use for help in writing.

8. Literature, art, and music will be selected to provide related experiences.

Evaluation Activities

Existence of a collection of student papers and anecdotal record forms completed by April 29, 1977.

OBJECTIVE NUMBER FIVE

To evaluate the improvement of language skills of second grade students in her bilingual class, the researcher will conduct the following activities between February 22 and May 9, 1977.

1. Administer, record, and analyze the following pre- and post-tests to treatment and comparison groups;
 - A. CTBS Language Test
 - B. Describe An Animal test of written language skills (or oral skills of children unable to write).
2. Record and analyze results of weekly anecdotal records kept on student language progress.

Evaluation Activities

Existence of a series of graphs and tables in which group progress is recorded in the area of language development.

OBJECTIVE NUMBER SIX

By May 9, 1977 the researcher will determine whether understanding of selected science process and concepts by

second grade students in her bilingual class has improved through correlation of language and process science instruction.

Implementation Activities

To evaluate improved understanding of selected science processes and concepts by second grade students in her bilingual class, the researcher will conduct the following activities between February 22 and May 9, 1977.

1. Administer, record, and analyze scores of the picture-concept test developed by the researcher.
2. Record and analyze results of weekly anecdotal records kept on progress in science.

Evaluation Activities

Existence of a series of graphs and tables in which group progress is recorded in the area of science processes and concepts.

DEFINITION OF TERMS

For the purpose of this study the following terms are defined as follows:

Bilingual Education: A philosophy and method of instruction by which students learn basic subjects in their dominant language while at the same time they learn English as a second language. Maintenance and development of both languages is integral. While this program is primarily designed to assist speakers of Spanish, English dominant students are also encouraged to participate.

Concurrent Presentation: A dual-language teaching technique in which languages are used interchangeably. Translation does not occur. Different points are made in each language.

CTBS: California Test of Basic Skills. It is used as a pre- and post-test in the Hollister Elementary School District each Fall and Spring. The reading, language, and arithmetic sections are administered.

Dominant Language: The mother tongue or first language a child learns; in this project, English or Spanish.

ECE: Early Childhood Education is a state funded program begun in 1973. Its purpose is to improve education in kindergarten through grade three. ECE requires much individualized teaching and provides for lower adult-child ratios in the classroom by funding classroom aides.

ESL: English as a Second Language is taught as a separate subject and is also integrated with other subjects in bilingual classes.

Experience Chart: A large chart for group or class reading based on the students' own experiences. Students dictate sentences which the teacher writes on the chart.

Language Development: Teaching the skills of listening, speaking, reading, and writing in both the first and second language.

Learning Center: A station in the classroom at which a small group or individual can learn by participating in a relatively self-directed game or activity.

Migrant Education: This program, federally funded in 1965, provides educational and limited health services to the children of families who migrate from place to place as a result of their employment in agriculture. The program provides the assistance of two aides for a total of 80 minutes per day. They work in small groups with the 11 migrant children in the researcher's classroom.

Preview-Review: A dual language technique in which one language is used to briefly introduce a lesson which will be taught in another language with the use of visual aids and previously taught vocabulary. The lesson is later reviewed in the first used language.

Title VII: The Bilingual/Bicultural program in the Hollister Elementary School District was funded under Title VII of the Federal Civil Rights Act. These funds provide materials in Spanish and English as a Second Language. Funds are also provided for teacher training in the area of bilingual education and training and employment of bilingual/bicultural aides. The Hollister program is known as "Salven Los Niños" or Save the Children.

LIMITATIONS OF THE PROJECT

There are several factors which may exert limitations on the results of this project. The time in which the language-science units will be tested will extend from February 22 through April 29, 1977. This may not be enough time to show significant increase in language skills. A period of nine weeks may not provide sufficient practice in

written language skills of spelling, punctuation, and syntax which are the aspect of language development for which standardized tests are developed.

The CTBS Language Section, the standardized evaluation instrument used in this project, is not designed to be an accurate measure of changes over a short period of time. Additional means of evaluation developed by the researcher include criterion referenced tests such as a Describe An Animal oral or written test of language usage and a Picture-Concept test of science concepts. These tests are not standardized and therefore lack validity and reliability.

Another factor which may limit the results of the project is the diversity of abilities of the students in the class. Several of the students did not attend school before this term. As a group the limited reading level makes evaluation on a standardized test difficult. Guessing may cause an unusually high variation in reliability. Within the class there are four groups whose needs differ greatly with respect to dominant language and second language development, oral and written language skills. Testing (other than the CTBS) will therefore necessarily be in English and Spanish and orally as well as in writing.

A fourth factor which may limit the results of the project is the individual difference in the methods used by the three instructional aides in the implementation of the language-science units. Their assistance is greatly needed because of the diversity of student abilities. The aides are

capable, experienced people. However, due to lack of academic training and need for more extensive planning with the researcher, there are at times variations in the accuracy or concentration with which a concept or skill is covered.

Time for preparation may also be a limitation. Particularly in a bilingual classroom, collection, preparation, and set up of special materials for several different groups is very time consuming. Set up and clean up of science materials each day requires much student and teacher time. Time required by other subjects, including the extra subjects such as Spanish as a Second Language and beginning English as a Second Language which are a part of this bilingual program require much preparation time. Bilingual team planning also requires much time.

SUMMARY

Chapter One states the purpose of the project. The researcher proposes to develop a series of instructional units in which language skills and the internalization of science processes may be correlated in the bilingual classroom. The background and need for the study has been established. Objectives, implementation activities, and evaluation activities are stated. A timeline shows the sequence of the activities and evaluations. Terms are defined and the limitations of the project are presented.

Chapter two will present a review of the literature relating to the project. The psychological foundations will deal with current theories of cognitive development and their

relation with language learning. The philosophical foundations will trace the background of quality education for all children through current efforts to adapt educational methods to the diverse needs of children. The Socio-Educational Foundations include present difficulties in educating disadvantaged youth and methods of improving education. The teaching of language in a bilingual setting will be dealt with as well as the methods of teaching science by a process approach.

Chapter Three will present the findings of this study as derived from test scores and anecdotal records during the implementation and evaluation of the project as stated in Chapter One.

Chapter Four will present the conclusions and implications of the project and recommendations for the application of ideas gained through this project to the researcher's classroom and to other situations.

The Bibliography will contain a listing of all resources used in the writing of this thesis.

The Appendix of the project will include a copy of the tests and language assessment scale used by the researcher, and a sample of lesson plans used during project implementation.

Chapter 2

REVIEW OF THE LITERATURE

The soul and the strength of America has often been attributed to its diversity. However, the diverse needs of a large percentage of the nation's children are not presently being served. As a result, education in the United States is seen as less than successful by a growing number of students, parents, and educators. Problems in the schools are causing tremors which are felt in social and political areas.

Ways are now beginning to be developed which appear to hold out some hope of providing a good education for all of America's children. The success of these new approaches will be determined by their effectiveness in preparing the nation's children, all of them, for a satisfying and productive life.

One approach to this involves the theory that students, and particularly students from economically disadvantaged backgrounds, learn best from physical interaction with the environment.

The review of literature in this chapter focuses on the work of those psychologists and educators who have studied this theory of learning. The philosophical foundations relate to the conviction that all children deserve a good education. Recent philosophical discussion

and legal decisions have emphasized that the same kind of education for all does not equal good education. The socio-educational foundations outline the problems faced by schools in providing quality education for economically disadvantaged students and show examples of successful methods in this area. A survey of literature relating to studies correlating successful language teaching with discovery or "action" science programs concludes the review.

FOUNDATIONS OF EDUCATION

Psychological Foundations

The life work of the Swiss epistemologist, Jean Piaget might be considered a basis of those methods of teaching known as the inquiry method or discovery learning. Piaget's investigations, carried out by observing children engaged in various manipulative situations, and questioning techniques to determine the children's concepts about the objects of their play and their surroundings, have led him to conclude that learning takes place through a child's interaction with his environment. All that a child learns is based on his observing, touching, sizing up and manipulating the world around him. Piaget observed that all children follow a specific pattern of cognitive development. For example, a child of four or five often has not achieved a conception of one to one correspondence. He cannot count objects. A child of six is generally able to perform this task to some degree.

Piaget has defined four major stages in the intellectual development of the child and young adolescent.¹ The Sensori-motor level which occurs approximately from birth to age two is a period in which the child develops an awareness of his own body, his ability to move and observe his immediate surroundings. Thinking is concentrated on the present and concrete. The preoperational stage of learning occurs from approximately age two to six. The child actively explores his environment and the people in it. This exploration is carried out mainly through imaginative play, questioning, listening, and talking. During this stage the memory develops. The child's conception of time and space are beginning to take form. The concrete-operational level of intellectual development occurs from about age six or seven through eleven or twelve. By the age of seven or eight most children are able to deal with many concrete situations as would an adult in that they have a conception of number. Conservation of mass is generally understood. This means that the child realizes that a change in shape does not mean that an object has also changed in size. A number of concepts can be linked together and as a result, the child develops in his understanding of relationships. Reasoning associated with logic, mathematics and the other sciences

¹Nathan Isaacs, A Brief Introduction to Piaget, New York: Agathon Press, 1961, p. 13.

begins to develop. The stage of Formal operations occurs at about age twelve or older. At this stage the young adolescent is beginning to consciously be able to think on an abstract plane.

In Piaget's theory of conceptual development, the sequence in which a child learns is the same for all children. While Piaget's observations were limited to Swiss children of middle socio-economic strata, his studies have been replicated by numerous investigators in many different parts of the world, including Australia, Japan, Israel, Nigeria, Britain, India, Iran, and the United States.²

In recent years Professor Piaget has written and visited the United States speaking about the application of his work to the field of education. He emphasizes that "Maturation simply opens up possibilities and is never sufficient in itself to actualize these possibilities."³

The child in a sterile environment, whether that of an institution such as an understaffed and crowded orphanage or a tenement crowded with people and having few items of furniture, pictures, books or other objects to explore has had much less opportunity to learn than a child in a more stimulating environment.

²Sohan Modgil, Piagetian Research: A Handbook of Recent Studies, (Windsor, Berks, G.B., NFER Publishing C., 1973), pp. 225-44.

³Charles E. Silberman, Crisis in the Classroom, (New York: Random House, 1970), p. 216.

Basil Bernstein, the English sociologist, believes that language itself has some influence on internalization of concepts. Bernstein gives an indication why children of lower socio-economic classes frequently have difficulty with language and reading upon entering school. Bernstein recorded and documented differences in the "linguistic codes" to which children of different classes are exposed in their home environments. A "restricted code" of speech is used by lower socio-economic class families. This code is simple, condensed and lacking in detail. Middle class families use a more "elaborated code" which is more syntactically complex, more precise and differentiated. Bernstein feels that the absence of exposure to more elaborate codes results in lower class children doing poorly on intellectual tasks.⁴

Jerome Bruner, cognitive psychologist of Harvard, while in agreement with much of Piaget's work takes exception to Piaget's theory that cognitive level precedes linguistic development. Bruner feels that language is instrumental in development of cognitive abilities. "Language provides the means of getting free of immediate

⁴Basil Bernstein, "Social Structure, Language, and Learning," Education of the Disadvantaged, from Educational Research, 3, 1961, pp. 163-176, in Harry Passow, Mirriam Goldberg and Abraham Tannenbaum, eds., (New York: Holt, Rinehard and Winston, 1967), pp. 225-244.

appearance as the sole basis of judgment,"⁵ he says, summarizing the work of his student, Frank, who found that in some cases previous discussion of a conservation task made it easier for a child to understand the task.

However, other investigators point to numerous studies which indicate that logical development of a concept precedes the ability to talk about it. A series of such studies was conducted by Hermaine Sinclair-de-Zwart in 1967. Sinclair studied whether children who performed better in Piagetian situations also would show more linguistic development. This was found to be the case. In order to see whether improved language would lead to improved performance on intellectual tasks, Sinclair and Barbel Inhelder then attempted to teach less linguistically advanced children the language patterns of those who were more advanced. They found this to be extremely difficult. The subjects' language appeared to be limited by the low level of intellectual ability indicated on the test of Piagetian tasks. Even with those children whose language improved, their performance on the intellectual tasks did not improve. Inhelder and Sinclair, in agreement with Piaget, concluded that "intellectual operations appear to

⁵Jerome S. Bruner, Toward a Theory of Education, (Cambridge, Massachusetts: Belknap Press of Harvard University Press), 1967, p. 16.

give rise to linguistic progress and not vice versa.⁶

The work of Psycholinguist Noam Chomsky initiated a new trend in the study of language acquisition often referred to as transformational linguistics. As opposed to those who believe that language learning occurs through association and reinforcement of words, Chomsky theorized that while the above are factors in learning, the child employs an ability to generalize and hypothesize which perhaps gives evidence of an innate "language acquisition device" (LAD) as the major means of learning language.⁷

Chomsky and Piaget are in agreement that understanding generally precedes linguistic output although Piaget maintains that interaction with the environment rather than an innate device is the key to language development.

Piaget expresses the view that schools have a great responsibility to help the child develop his potential through "...the use of active methods which give broad scope to the spontaneous research of the child or adolescent..."⁸

⁶ Jean Piaget, Genetic Epistemology, Trans., Eleanor Duckworth, (New York: Columbia University Press, 1970), pp. 48-50.

⁷ Carolyn Kessler, The Acquisition of Syntax in Bilingual Children, (Washington, D.C.: Georgetown University Press, 1971), p. 17.

⁸ Jean Piaget, To Understand Is To Invent, the Future of Education, George-Anne Roberts, Trans. (New York: Grossman Publisher, 1973), p. 15.

Psychologist Robert M. Gagné was a principal developer of Science-A Process Approach (S-APA) sponsored by the American Association for the Advancement of Science. He points out that learning is most effective when the child actively investigates his environment. This, he explains, is the basis of the Process Science program. At a regional meeting of S-APA tryout teachers in 1965, he stated:

if transferable intellectual processes are to be developed in the child...these intellectual skills must be separately identified, learned, and otherwise nurtured in a highly systematic manner...one must learn to carry out critical and disciplined thinking in connection with each of the processes of science.⁹

One of the key ideas of S-APA is the progressive building of more complex intellectual processes from simpler ones. Gagné explains this kind of learning in his Conditions of Learning in the discussion of chaining.¹⁰ Gagné also explains how the Process Approach puts learning as interaction with the environment into practice.

The arrangement of the learning situation should be such as to insure that the overt activities required are produced from the individual's own internal processes, rather than being tied to specific stimuli provided by the teacher. In other words, learning will be most effective when relationships are 'discovered' rather than copied, when generalizations are attained

⁹Robert M. Gagné, "The Psychological Bases of Science-A Process Approach," American Association for the Advancement of Science, AAAS Misc. Publications, P965, pp. 65-8.

¹⁰Robert M. Gagné, Conditions of Learning, (New York: Holt, Rinehart and Winston), 1965, p. 185.

rather than being imposed...An implication of this for developing units of instruction is that achievement by the individual of a specific goal, understanding, or capability should be measured in terms of various kinds of performances, not just verbal responses.¹¹

In Conditions of Learning, Gagné explains that the child uses science and math skills early, counting, comparing size, and measuring. The child is also often engaged (in play as well as in more formal situations) with classifying. For example, yellow becomes for the child not just a color, but a class of things which are yellow. He also becomes aware of directional concepts--behind, below, over, for example.¹²

To the teacher, the realization that concepts which are an integral part of science learning are the same concepts which have always been part of basic primary language skills development may lead to the conclusion that science and language may effectively be taught together. The science lesson will provide a vehicle for language learning. Discovery methods of teaching science are of particular value in a bilingual classroom where many children are learning a new or second language in addition to developing skills in their dominant language.

¹¹Robert M. Gagné and Mary Lela Sherburne, "Psychological Bases of Science-A Process Approach, AAAS Misc. Pub., 1965), pp. 65-8.

¹²Gagné, Conditions of Learning, pp. 182-3.

Can the effects of limited cognitive and linguistic development be counteracted? Yes, argue a number of students of child development, at least to a certain extent. Jean Piaget believes that the concept of innate intelligence or lack of it is not valid in light of the role played in development as the result of environmental stimuli. Particularly if a wide variety of experience is made available early, in addition to concern and proper guidance, a child does not necessarily have to be sentenced to a life of low intelligence. Piaget expressed this concept by saying "the more a child has seen and heard, the more he wants to see and hear."¹³

J. McVicker Hunt discusses the results of poverty by saying that the child of poverty, during his first year, probably has more actual physical stimuli than a more economically fortunate child. In the crowded conditions of the poor, the child sees and hears many people who hold him, talk to him, and live in the same small space. However, after the age of two the poverty of environmental stimuli begins to make the difference between this child and the product of a middle class family. The child wants to crawl, walk, explore, touch, taste, and listen to others talk. He is often limited by sometimes short tempered

¹³J. McVicker Hunt. "How Children Develop Intellectually," from Children, May-June 1964, pp. 83-91, in The Disadvantaged Child, eds. Joe L. Frost and Glenn R. Hawkes, (Boston: Houghton Mifflin, 1966,) p. 84.

adults who are also suffering from overcrowding and from their own frustrations. Late in the second or third year the child meets another obstacle. He receives few answers to his questions, and few names for things he wants to know. While other children are pointing to pictures in books, animals in the zoo, or flowers in the park or garden, the child of poverty sees much less, hears much less, and finds fewer people willing or able to carry out extended conversations.¹⁴

Numerous studies indicate that children of low socio-economic level families benefit greatly from early participation in activity-based inquiry oriented science programs. Mary Budd Row states:

Research shows that the very group which would benefit most from early exposure to an activity based inquiry-oriented science program of some kind is least likely to get it. The poor, the handicapped, the low socio-economic group children in kindergarten through primary schools show substantial gains in verbal fluency, language complexity, and logic as well as in attitudes...yet it is the poor, the reluctant readers, the handicapped who are most often kept from science on the grounds that they need other things more.¹⁵

Philosophical Foundations

Since passage of the Elementary and Secondary Education Act of 1965 and the amendment in 1967 to include

¹⁴Hunt, pp. 83-91.

¹⁵Mary Budd Rowe, "Help is Denied to Those in Need," Science and Children, 12:6, (March 1975), pp. 23-5.

bilingual education, an effort has been made to provide education fitted to the special needs of the economically disadvantaged.

Johann Pestalozzi, the Swiss educational reformer, can be considered the initiator of a number of concepts we today consider integral parts of American educational philosophy. Many of Pestalozzi's tenets of education were the result of painful experiences in his own youth. His memories of the harshness and memorization which formed a part of schooling in the eighteenth century caused him to dream of a school in which all children, not just those of the well off, would be educated.

In his writing and during his later years as director of the schools at Bergdorf and Yverdon, he insisted that education should be approached from the standpoint of the child's interests.

In teaching, Pestalozzi advocated proceeding from the concrete to the abstract. He taught art as a form of expression and also in order to develop a sense of power over one's environment. Today we would refer to this concept as one of developing self esteem. In this sense his schools were the predecessors of Maria Montessori's Casa de Bambini and the British infant school's open classroom. He felt that the teacher must always serve as an example to his students with regard for his concern for

his fellow men.¹⁶

Johann Pestalozzi was especially concerned with building the child's understanding from the simple to the more complex. He believed in mastery learning. "Be not in a hurry to get on, but make the first step sound before moving," he wrote.¹⁷ Much of his method involved the teaching of science and a love of nature through outdoor observation. He encouraged children to think for themselves about what they saw. "Lead your child out into nature, teach him on the hilltops and in the valleys. Be silent and let nature teach."¹⁸

John Dewey, (1859-1952) laid the philosophical groundwork for present day American education. His belief that the child learns by doing rather than by being shown reflects Pestalozzi's ideas. Dewey's work influenced the trends toward learning through making and doing. Particularly in the elementary grades, learning through actual experience began to be considered as valuable as learning through reading. The role of lecture and rote memorization declined as a result of his methods.

¹⁶ Mary Lavater-Sloman, Pestalozzi, Die Geschichte Seines Lebens, (Zürich: Artemis-Verlag, 1954), p. 248.

¹⁷ Johann H. Pestalozzi, Diary, 1780, in The Great Educators, eds. Hugh C. Black, Kenneth V. Lottich, and Donald S. Seckenger (Chicago, Nelson Hall, 1972), citing F.V.R. Painter, trans., Great Pedagogical Essays, Plato to Spencer, (New York: American Book Co., 1905).

¹⁸ Ibid.

John Dewey did not feel that the average person should be given one type of education, while those destined for leadership should receive education of a different sort.

He stated:

A society which is mobile, which is full of channels for the distribution of a change occurring anywhere, must see to it that its members are educated to personal initiative and adaptability. Otherwise, they will be overwhelmed by the changes in which they are caught and whose significance or connections they do not perceive.¹⁹

With the present effort to compensate for a conceptual and linguistic deficit in many students entering school, and considerable pressure on the school to "teach the basics" we run the risk of continuing to do what Dewey warned against in 1916 and which has haunted American education despite him. A broad education for some students and a subsistence curriculum for the children of poverty. Charles Silberman warns about the narrow education most poor children now receive, referring to "...the anti-democratic assumption that only 20 percent of children could benefit from intellectually oriented education."²⁰

Lawrence A. Cremin comments on the official trend to "life-adjustment courses" recommended by the U.S. Department of Education for average students. Such courses

¹⁹Dewey, Democracy and Education, p. 102.

²⁰Silberman, Crisis in the Classroom, p. 170.

often lack worthwhile content. "Dewey saw the task of the educator as one of endowing ordinary human experience with intellectual, moral, and aesthetic experience."²¹ Cremin adds that "no society that calls itself democratic can settle for an education that does not encourage universal acquaintance with the best that has been thought and said."²²

In 1959 a conference was held at Woods Hole, Massachusetts to discuss the need for improvement of science instruction at the secondary and elementary levels. Called by the National Academy of Sciences and attended by outstanding members of the scientific and educational community, this conference laid the groundwork for the secondary science curriculum revisions which went into effect in many schools during the early and middle 1960's. Participants in the program were initiators in the development of the several highly rated elementary science program including Science-A Process Approach, the Elementary Science Study, and Elementary Science Curriculum Study. Jerome Bruner in his Process of Education reported on the proceedings of the Woods Hole conference. The influence of Piaget's work was great and discovery methods were

²¹Lawrence A. Cremin, Transformation of the School, (Maryland: Alfred A. Knopf, 1961), p. 335.

²²Cremin, The Genius of American Education, (New York: Basic Books, 1976), p. 85.

recommended as vital to the new curricula. Bruner's concept of the "spiral curriculum"²³ in which children learn early some of the simpler concepts and build upon them toward the more complex became an important aspect of elementary science curriculum including the S-APA materials. Bruner recognized a developing national drive for improved science education which was given impetus by the launching of Sputnik. He writes:

If teaching is done well and what we teach is worth learning, there are forces at work in our contemporary society that will provide the external prod that will get children more involved with the learning process than they have in the past.²⁴

During the sixties and early seventies a philosophical controversy developed over provision of education in the dominant language of minority students, and the extent to which the students' cultural background should be included in the curriculum. The landmark court decisions and legislation focused national attention on the needs of cultural and language minority students and the problems they continue to encounter in an effort to have an equal educational opportunity.²⁵

Dr. Wallace E. Lambert has conducted numerous

²³Jerome S. Bruner, *Process of Education*, (Cambridge: Harvard University Press, 1960), p. 5.

²⁴Bruner, *Process of Education*, p. 73.

²⁵U.S. Commission on Civil Rights, *A Better Chance to Learn: Bilingual/Bicultural Education*, (Clearinghouse Printing Office I, May 1975), pp. 1-3.

studies of student progress in bilingual settings. An experimental program in northern Maine was developed in an area where 85 percent of the families still spoke French in the home. A random selection of schools offered part of the elementary curriculum in French. Control groups with children of comparable intelligence and socio-economic background were taught only in English. After five years the children in the bilingual program outperformed those in the control groups in English language skills, math, and other academic subjects.²⁶ This would indicate that children who are bilingual or limited speakers of English probably profit greatly from instruction at least part time in their dominant language.

Inclusion of the students' cultural background in the curriculum of the bilingual class has a definite relationship with the schools' concern for optimum academic progress. Dr. Lambert and Dr. G. Richard Tucker also state:

...feelings of social uncertainty or dissatisfaction which often characterize the immigrant and the bilingual may also, we believe, affect the serious student of a second language.²⁷

²⁶Wallace E. Lambert, "The Effects of Bilingual Education on the Individual: Cognitive and Socio-Cultural Consequences," (paper presented at a multidisciplinary conference on Bilingualism held on the Plattsburgh Campus of the State University of New York, March 12-13, 1976).

²⁷Wallace E. Lambert and G. Richard Tucker, Attitudes and Motivation in Second Language Learning, Rowley, (Mass.: Newbury House, 1972), p. 13, cited by U.S. Commission on Civil Rights, A Better Chance, p. 60.

By giving the language and culture of the language minority children recognition within the curriculum, bilingual/bicultural education allows the child to feel acceptable as a language minority individual and thus to develop positive attitudes towards learning English and the dominant cultural group.²⁸

Dr. Murial Saville-Troike expressed the opinion that the United States has matured to the point where it is no longer necessary to insist that immigrants forget their heritage. We no longer need think of America as a "melting pot" but as a salad bowl in which the distinctive ingredients give character to the whole.²⁹

Socio-Educational Foundations

Any discussion of educational improvement for children of low socio-economic groups must recognize the inter-relationship of human factors and environmental stress as well as factors influencing public education. Burton L. White and others studied the way mothers affect the development of their children aged one to three.

²⁸U.S. Commission on Civil Rights, A Better Chance, p. 60.

²⁹Murial Saville-Troike, "From Melting Pot to Salad Bowl: The Promise and Reality of Multicultural Education," Keynote speech for the New York ESL Bilingual Association Convention, Syracuse, N.Y. October 19, 1974.

They found that in every economic group some mothers sparked the maturing child's natural curiosity. These mothers tended to develop "exceptionally able" children. In other families the investigators noted that the way the mother interacted with the children resulted in "exceptionally unable" children.³⁰

Environmental stress, however, obviously modifies the effectiveness of family guidance. Extensive studies such as that done by Lawrence A. Cremin and reported in his Youth in the Ghetto show the debilitating effects of poverty on parents and children.³¹ Other writers including Charles Silberman, Paul Goodman, Oscar Lewis and Stan Steiner clearly indicate the extent of psychological and physical hunger amid plenty which characterizes the situation of the poor in America.

When James Coleman published the results of the three year study Equality of Educational Opportunity, he cited the national situation of poor, shabby, and depressing schools available to children of low socio-economic groups. Surprisingly, however, he found that the quality of schooling a child receives makes very little difference

³⁰ Burton L. White, Jean Carrew Watts and others, Experience and Environment: Major Influences On the Development of Young Children, 1, (Englewood Cliffs, New Jersey: Prentice Hall, 1973), p. 20.

³¹ Lawrence A. Cremin, Youth in the Ghetto, (New York Basic Books, 1964), p. 25.

in his performance on standardized tests.³²

Christopher Jencks, in an extensive analysis of the Coleman Report titled *Inequality*, states "Comparing the 'best' schools observed by the Coleman team with those of the poorest quality, test scores differed on the average less than ten points between the two." As a result, Jencks concludes, "...variations in what children learn in school depend largely on variation in what they bring to school, not in what the school has to offer them."³³

Charles Silberman adds in this regard:

This finding has been misinterpreted as meaning that schools have no effect on students' learning. It means nothing of the sort. The evidence suggests only that the schools are remarkably uniform in their effects on students' learning. Differences in student achievement from school to school seem to be due more to differences in the students' own family background and in the backgrounds of their fellow students than to differences in the quality of the schools themselves.³⁴

However, despite the small differences the type of school attended appears to make, standardized test scores of Mexican-American students nationally lag behind those of so called white students by nearly two and a half years

³²James S. Coleman and others, *Equality of Educational Opportunity*, (Washington, D.C.: U.S. Government Printing Office, 1966), cited by Charles Silberman, *Crisis In the Classroom*, p. 70.

³³Christopher Jencks, *Inequality*, (New York: Basic Books, 1972), p. 55.

³⁴Silberman, *Crisis in the Classroom*, pp. 70-72.

in the sixth grade and nearly three years by the twelfth.³⁵ Whether the origin of differences in test scores should be attributed to language deficiency as is done by Basil Bernstein, Carl Bereiter and Siegfried Engelmann,³⁶ or whether environmental deprivation is responsible, as is stressed by J. McVicker Hunt, Benjamin Bloom, Martin Deutsch and others, the problems of low test scores remains.³⁷

An interesting and different approach to differences on intellectual tasks was proposed by Michael Cole and Jerome S. Bruner in which they challenge the "deficit hypothesis" and maintain that children from the "out-culture" have developed intelligence equal to that of children from the "in culture". It is expressed, however, in different ways.

One can find a corresponding situation in which the member of the 'out culture', the victim of poverty, can perform on the basis of a given competence in a fashion equal to or superior to the standard achieved by a member of the dominant culture.³⁸

³⁵Silberman, p. 63.

³⁶Siegfried Engelmann, Preventing Failures In the Primary Grades, (Chicago: Science Research Associates, 1969), p. 28.

³⁷Silberman, p. 82.

³⁸Michael Cole and Jerome S. Bruner, "Cultural Differences and Inferences About Psychological Processes," American Psychologist, October 1971.

Frank Angel of New Mexico Highlands University refers to this article in proposing modifications in existing bilingual/bicultural teaching methods. He adds that as yet little is known which will assist teachers in taking advantage of the cultural strengths present in students in order to help them take advantage of the dominant cultural lifestyle while retaining their own cultural identity.³⁹

What methods presently known for teaching concepts and language skills are effective and at the same time promote an enjoyment of learning and a feeling of accomplishment for the student? Charles Silberman cites several schools where disadvantaged children are learning and enjoying it. He gives details of methods used at Harlem Prep and the Cam Academy of Chicago. He attributes their success to a combination of dedicated teachers, solid curriculum, and relevant materials made possible by financial support by federal government, private industry, and church groups. Silberman also gives the example of the John H. Finley Elementary School in Harlem. In an atmosphere of spontaneity and joy children are encouraged to talk and write about what they are doing as part of their school experience. They care for animals and write

³⁹Frank Angel, "Social Class or Culture: A Fundamental Issue in the Education of Culturally Different Students," in Bernard Spolsky, ed., The Language Education of Minority Children. (Rowley, Massachusetts: Newbury House, 1972), p. 152.

what they did. Younger children dictate experience stories to their teachers, then "read" what they dictated until real reading is developed. The children hear reading on all sides; poems, stories, and labels around the room are incorporated into lessons. Learning takes place in small groups at centers so there is no need to impose the rule to "sit down and be quiet". Since teachers work with small groups, a much closer relationship develops between child and teacher than in the traditional classroom.

Principal Martha Froelich, functioning more in the capacity of the British Infant School head teacher than in the traditional American role involves parents and community in education. Taking a library book home every night with brief directions for parent help is a school policy. Children at Finley school, though certainly disadvantaged economically, are getting a rich educational experience. They enter school scoring well below the national median, but by the end of the first grade the same children score well above it. Even the children in the lowest quartile in the school score at the national median (1.9).⁴¹ As students reach upper grades, the school median does not drop below the national score.

Silberman also mentions other schools in New York and Washington D.C. which are providing quality education

⁴¹Silberman, Crisis In the Classroom, pp. 101-3.

in the ghetto. P.S. 146, at which over half of the students come from homes in which Spanish is spoken, consistently has good reading scores. And their scores were a full year above those of neighboring schools. The combination of active learning and correlation of language with subject matter appears to result in rapid learning and an accompanying sense of accomplishment and self-worth which reinforces the learning itself.

Numerous reports apply active learning techniques to instruction in similar settings. Mary Lela Sherburne reports on the experiences in the Model Schools of the District of Columbia. 360 teachers using the Elementary Science Study (ESS) materials found:

...unimagined rewards developing in reading, writing and mathematics...the impact of in-depth units on thinking skills, problem solving attitudes, and breadth of knowledge could not be measured by the usual tests.⁴²

Important aspects of the program were that the children learned through their own direct experiences. Each child had his own equipment, such as a jar of brine shrimp which he was raising. The child had the opportunity to find out for himself. Explanations were not given until the child had enough information to make inferences for himself and ask questions about his project. Children

⁴²Mary Lela Sherburne, "Disadvantaged Children and the Use of Concrete Learning Materials in Math, Science and Social Studies," in Joe L. Frost and Glenn R. Hawkes, ed. The Disadvantaged Child, Issues and Innovations, (New York: Houghton Mifflin, 1966), p. 117.

developed skills relating directly to their own investigation. Students voluntarily wrote down things they learned. Their math skills of measuring and graphing improved. Discussions of science activities done informally as the children worked provided much more practice than they would have gotten in a formal discussion. Science activities stimulated reading for information by many students, and the general classroom atmosphere during science activities was happy for students and teachers.

Sherburne points out that teacher education is essential when initiating this kind of program. Teachers need assurance that noise and "mess" is all right. They also need assistance in preparation and planning. With this support teachers liked the program and felt it improved their teaching style and their own attitude.

Mary Lela Sherburne also refers to Frank Reissman's suggestion that the learning style of disadvantaged students be considered and used to their advantage.⁴³

Reissman lists several characteristics of the learning style frequently noted among disadvantaged students. He mentions that students work at a pace that appears slow, but is often meticulous and thorough. Such a student may be a physical learner who needs to work out

⁴³Sherburne, pp. 116-124.

a concept with his hands in order to fully understand it. Reissman reminds the teacher that one must guard against the tendency to respond more to the child whose face lights up with understanding at the first explanation.

Disadvantaged learners are often quite verbal, but informally so. Teachers should not immediately insist on formally stated ideas. The researcher believes this point is especially important in correlating language with a content area such as science.

Frank Reissman also points out that disadvantaged students and their parents want education definitely leading to job competence. They often feel hostile to the school because they feel that they are not accepted there and in the past, the school has not provided the skills they need. Schools will gain more acceptance if they provide a strong curriculum of reading, language skills, and know-how for getting and keeping a job.

Other positive characteristics he noted are willing cooperation and mutual aid which is learned in the extended family, a sense of fairness, a lively humor, and informality.

The school should not try to change the values of the students. However, there is one area in which Reissman feels the schools should take a stand: The school should be ready with clear logic to counter the anti-intellectual attitude often held by members of lower

socio-economic groups, and show how knowledge can work to their advantage.⁴⁴

In a recent article on techniques of bilingual/multicultural education, Alfredo Castañeda and Tracy Gray discuss two cognitive styles of instruction and learning. Current research indicates that Chicano culture children often learn best via the "field sensitive" style, while U.S. culture children often learn best from the "field independent" style. The sensitive teacher will adapt teaching styles to needs of the child. Some characteristic field-sensitive behaviors include enjoying work with others to achieve a common goal, and liking to help others. The field-sensitive child seeks guidance and demonstration from the teacher and seeks rewards which strengthen the relationship with the teacher. He is highly motivated when working individually with the teacher.⁴⁵

An activity-science program is ideally suited to the needs of field-sensitive children. The teacher circulates and listens while the children discuss and demonstrate their projects. Children work in small groups and have ample time to help each other. Activities are taken a step at a time so that success is built into the activity. There are many opportunities for the teacher to

⁴⁵ Alfredo Castañeda and Tracy Gray, "Bicognitive Processes In Multicultural Education," Educational Leadership, 82:3, December, 1974, pp. 203-7.

commend each student individually on some part of his job.

Carol N. Dixon outlines strategies for teaching the Mexican American child. Very important, she feels, is the opportunity for children to do peer teaching. This is an outgrowth of the child's experience of helping sisters and brothers at home. The child's home experience is also the basis of an enjoyment of group learning. Not only do Chicano children enjoy working in groups; they prefer group improvement of skill rather than individual competition with peers. Their desire not to overshadow one's peers can be one of the most gratifying experiences for the teacher. The use of experience stories and charts can be a valuable instrument for reading and language development. Cards on which words from the experience stories are written can be the basis of sight vocabulary development. Children can work in pairs to read the stories and practice the cards together. Carol Dixon suggests giving less individualized reinforcement and more group reinforcement.⁴⁶ In light of this concept, the researcher believes individual reinforcement should generally be given in a one-to-one situation, and referring to the child's own growth rather than the presently common praising of a child in public in a sense of being better than his peers.

⁴⁶Carol N. Dixon, "Teaching Strategies for the Mexican American Child," Reading Teacher, 30:2, November, 1976.

Theodore Andersson of the University of Texas at Austin also mentions developing the bilingual child's interest in reading by using cards as labels for familiar objects at home and in school. He suggests that learning can begin quite early, two or three years of age using this method, and that the mother can make a great difference in the child's readiness for reading. The mother tongue should be the first language a child reads, says Andersson, and transfer to the second language will be nearly automatic when the child has a strong foundation.⁴⁷

The use of sight vocabulary cards to spark reading skills and interest brings to mind the "organic reading" Sylvia Ashton-Warner used to teach her Maori students in New Zealand. Particularly in teaching children from a culture in which reading has not gained great importance to the child's parents, she points out that the first words a child learn must be charged with much emotion for the child. Her experience indicated that as a child chose a word he really cared about (Mum, airplane, horse, fight, kiss had great appeal for her students) they would seldom fail to recognize it. Later when children began to write accounts of their experiences, the words in these stories also became important enough for the students to remember many automatically.

⁴⁷ Theodore Andersson, "The Bilingual Child's Right to Read," Journal of the National Association of Bilingual Educators, 1:1, (May 1976), pp. 17-22.

"In desperation I use their need to talk to each other," says Miss Ashton-Warner. "They read to each other and hurry each other along; their own turn depends on it. It leads to wide and happy fields--but noisy ones."⁴⁸

Alma Flor Ada and Maria del Pilar Olave emphasize the interrelationship between the child, his world, and literature. Particularly the child whose mother tongue is Spanish needs to hear rhymes, songs, riddles, and folktales in his own language to broaden his vocabulary, encourage him to look closely at his environment, and establish the validity and value of his own roots.⁴⁹

In an interview with the researcher, Alma Flor Ada emphasized the value to the child of developing an extensive vocabulary in his dominant language. This is an area which is often neglected in an effort to give the child the best possible basis in English. However, particularly for the young child hearing stories read in his mother tongue gives him added security at a time when many things are new and strange to him. The teacher who shows that she considers his language important enough to develop, shows the child that he is important, and his

⁴⁸Sylvia Ashton-Warner, Teacher, (New York: Simon and Schuster, 1963,) pp. 40-51.

⁴⁹Alma Flor Ada and Maria Del Pilar Olave, "Desarrollo linguistico y vivencia cultural a traves de la literatura infantil," Journal of the National Association of Bilingual Educators, 1:1 (May, 1976), pp. 65-72.

parents who also use the language are important also. Development of the mother tongue builds rapport between the child and the school. First language development also leads to better understanding of the second language. Stories which have become familiar when first read in the dominant language are more easily understood when later they are heard in English.⁵⁰

Related Studies

Edythe J. Gaines points out the vital relationship between improved education of the disadvantaged and the need for science in the curriculum. The school that seeks to improve poor reading progress by teaching more reading in place of science defeats its purpose, she says. Science taught by discovery methods plays an important role in developing a child's thinking powers, and other skills which are the basis of "the basics" such as reading.⁵¹

Today, though technological advancement surrounds us, students' knowledge of science is on the decline. Latest figures published by the National Assessment of Educational Progress (NAEP) show that science achievement

⁵⁰Based on an interview with Alma Flor Ada on December 2, 1976.

⁵¹Edythe J. Gaines, "Do We Owe Children Science as Part of the Basics?" p. 28.

scores dropped by two percent between 1969-1970 and the 1972-1973 school year. This is equal to about a half year of school experience. Students 9, 13, and 17 years old were tested on questions dealing with health and other life situations. Boys outperformed girls by more than two percent by age nine and six percent by the end of high school.⁵²

Many educators believe that the deficit of science teaching is the consequence of teachers' sincere but misguided notion that they are too busy teaching more important things such as reading and language arts... results of recent research in science education indicate a positive relationship between childrens participation in nationally recognized science elementary programs and the development of oral language skills and reading readiness...⁵³

write James P. Barufaldi and Jennifer Wallenfels Swift. They cite numerous studies associating cognitive development through science instruction with development of syntax and vocabulary.

Donald B. Neuman reports significant growth in reading readiness as a result of science instruction based on S-APA and SCIS materials. He feels that, in accordance with Piagetian concepts, a child cannot read with understanding things he cannot talk about. He cannot talk

⁵²Knowledge of Science Declines," Science News, March 29, 1977, p. 26-8.

⁵³James P. Barufaldi and Jennifer Wallenfels Swift, "Children Learning to Read Should Experience Science," The Reading Teacher, 30, (January, 1977), pp. 388-93.

about things he does not understand, and he cannot understand what he has not experienced, preferable by doing or acting out for himself.⁵⁴

As early as 1949, Millie C. Almy observed that experiences with active learning methods enhanced kindergarten children's later success in beginning reading.⁵⁵

Jerry B. and Mary N. Ayers report that kindergarten children develop the use of logic in problem solving through experience with S-APA materials. They also showed significant gains on standardized reading tests which were not matched by children who had not participated in the science program.⁵⁶

Four years earlier, Jerry B. Ayers and George Mason had reported similar findings with a group of kindergarten children in Atlanta, Georgia. When tested using the Metropolitan Reading Test, children who had

⁵⁴Donald B. Newman, "You Don't Have Time Not To Teach Science To Children," Science and Children, 12, (November-December, 1974), pp. 29-31.

⁵⁵Millie C. Almy, Children's Experiences Prior to First Grade and Success in Beginning Reading, New York: Teachers College Press, Columbia University, 1949, current issue, New York: AMS Press, Teachers College series No. 954, reprint by special arrangement with Teachers College Publications, 1972.

⁵⁶Jerry B. Ayers and Mary N. Ayers, "Influence of S-APA on Kindergarten Children's Use of Logic in Problem Solving," pp. 435-39.

participated in science programs scored significantly higher on total reading readiness scores. They were higher in Listening, Numbers, and Copying. These students had also been using S-APA materials.⁵⁷

Donald H. Kellogg also used the Metropolitan Reading Test to determine comparative effects of discovery science instruction (SCIS) and a formal reading readiness program (Harper Row). He found that the group which had participated in the SCIS program did significantly better on reading than those in Word Meanings, Listening, Matching, Alphabet, and Numbers. The control group did better on copying.⁵⁸

Phyllis Huff and Marlin Languis tested the use of S-APA activities on listening and oral language of low socio-economic group kindergarten children. Using the Test of Oral Communication Skills (TOCS), they found that children in the S-APA program did better on speaking skills, but not as well on listening.⁵⁹

⁵⁷Jerry B. Ayers and George E. Mason, "Differential Effects of Science-A Process Approach Upon Change in Metropolitan Reading Test Scores Among Kindergarten Children," Reading Teacher, 20, (April, 1969), pp. 435-39.

⁵⁸Donald H. Kellogg, An Investigation of the Effects of the Science Curriculum Improvement Study's First Year Unit, Material Objects, in Gains in Reading Readiness. Unpublished dissertation, University of Oklahoma, 1971.

⁵⁹Phyllis Huff and Marlin Languis, "The Effects of the Use of Activities of S-APA on the Oral Communications Skills of Disadvantaged Kindergarten Children", Journal of Research in Science Teaching, 10, 1973, p. 165.

Supporting these findings of growth in oral language during science activities is the study made by Mary Budd Rowe. She reported that much more spontaneous language activity occurred during SCIS science classes than during formal language arts classes; as much as 200 to 500 percent more. She relates that much interest, development of intellectual curiosity, and experimentation was stimulated by this type of science learning.⁶⁰

Another study directly linking science instruction to development of Language skills was carried out by Mary Ellen Quinn and Carolyn Kessler. In a report presented to the annual meeting of the American Educational Research Association, Dr. Quinn stated that students in a sixth grade class participated in an activity based study of science. As their ability to form hypotheses increased, so did the syntactic complexity of their written language used to express the hypotheses.

Given the theory current in developmental psycholinguistics that language acquisition results from a series of evolving hypotheses tested and either accepted or rejected, it seems reasonable to assume that children specifically taught to improve the quality of their hypotheses formulated in a science class should give evidence of progressing into higher levels of language development.⁶¹

⁶⁰Mary Budd Rowe, "Help Is Denied Those Who Need," pp. 23-5.

⁶¹Quinn and Kessler, "Relationship Between Science Education and Language Development," p. 3.

This proved to be the case as the experimental group made significantly higher gains in both ability to form hypotheses and syntactical development.

If young children involved in a science activity program, making use of the inquiry or process approach, generate more complex syntactic structures, one may expect these same children to read better, to achieve better in many language-based activities than children who have not had a similar science experience. Reading, in other words, need not be separated out from the teaching of other content areas in the curriculum. Furthermore, since a science curriculum which facilitates conceptual development in turn facilitates language development, the role of science education may be a crucial one in bilingual programs, assisting children in the development of their two languages. Instead of actually teaching the structure of a language directly, making experiences available, such as the type of science experience presented in this study, will provide the conditions under which language acquisition is facilitated. Language structures clearly do develop in experience-based instruction."⁶²

CONCLUSIONS

The researcher agrees with the writers who, in accordance with Piaget's investigations, believe that the development of cognitive learning is the result of the child's interaction with his environment. In the classroom, learning which takes place as the result of the child's directed activity with selected materials in an atmosphere of acceptance and freedom to explore will probably be greater and will more positively affect the

⁶²Quinn and Kessler, p. 19.

child's self-esteem and his positive outlook toward others.

The discovery method of learning captures and holds the interest of the child and stirs his natural drive to touch, test, take apart, taste and tell his companions what he has done. The teacher could not possibly elicit as much oral language practice in a formal classroom setting, nor would it be as effective there. But the teacher must not allow the learning to stop at this stage. The teacher's time must be organized to facilitate the children's dictation of those exciting bits of information they cannot yet write for themselves. Time must be allowed for children to write their own accounts of what they are doing. Time must be found to read stories and poems, tell riddles and sing songs about the concepts the children are exploring, and this literature must include much in the language the child understands best.

Such an activity-based science program can effectively be used to build the language and reading ability and comprehension of the student.

Chapter 3

PRESENTATION OF FINDINGS

INTRODUCTION

The purpose of this chapter is to review the objectives of the project, describe the implementation activities and evaluation procedures for each objective stated in Chapter One, and to analyze and report the data obtained in the evaluation. Statistical treatment of the data consisted of the application of the T test, the Wilcoxon test, or the Friedman Analysis of Variance for the evaluative instruments used. The .05 level of significance was used to determine statistical differences, (except when the .01 level applied.)

The purpose of the project was to develop a series of four instructional units correlating language and science in a bilingual classroom. Each unit was designed to include language development activities in the students' dominant language, English or Spanish. The units also included science process skills as presented in Science-A Process Approach (S-APA). The instructional units were implemented in the researcher's bilingual second grade classroom. Student progress was evaluated using a standardized instrument, the CTBS Language test and two criterion referenced tests measuring language skills and science concepts.

Development of the project was based on a need for improved language skills instruction as shown by district-wide standardized testing as well as specific results of CTBS language tests of the target population. Correlation of language with science provided a means by which learning could take place through physical interaction of the student and selected elements of the environment. Activities were designed to promote understanding of a concept before the student was required to express the concept orally or in writing.

DEMOGRAPHIC DATA

The target population for this project included two bilingual second grade classes. The two classes were selected because they represented the closest similarities in class size, language background, academic progress of students, and instructional support personnel. Table 3.1 shows a comparison of the classes participating in the study.

Three bilingual aides assisted with language development in both treatment and comparison groups. One was the regular classroom aide provided by the Title VII bilingual program of the district. The other two aides were members of the staff serving migrant students and were scheduled for small group assistance in language development for those students one period per day.

Table 3.1

Comparison of Characteristics of the Students
in the Participating Classrooms

Characteristics	Treatment	Comparison
Total number of students	29	28
Language facility		
Spanish dominant	5	6
English English	9	9
Limited English	6	7
Bilingual	9	6
School experience/achievement		
Limited previous attendance	5	4
Average attendance	24	21
Mentally gifted	0	3

PLANNING AND IMPLEMENTATION ACTIVITIES

A survey was made of elementary science materials and programs. Their use and effectiveness as reported in journals of science education and other sources was compared. Several programs were reported to be most effective and appealing to students and teachers. All of these were discovery or action science programs of the type recommended for development at the Woods Hole, Massachusetts conference on revision of science education.

The S-APA materials were chosen because of the sequential nature of the units and specific processes and concepts which were included in the objectives for each unit.

Plans were made for implementation of language development activities which would be correlated with the S-APA science units. Additional materials were collected and developed. Additional activities similar in nature to the S-APA activities were added to the program. These activities were primarily in the form of learning centers and games.

Tests of language development and science concepts were surveyed. It was determined that while no standardized tests completely filled the requirements of the project, to evaluate the progress of students of varying linguistic abilities, the use of the CTBS Language test, in addition to criterion referenced tests developed by the researcher, would provide a basis for evaluation. Biweekly evaluation of written assignments and weekly categorized anecdotal records of oral language usage would serve to further evaluate the progress of students in the treatment group.

Following a period of student pretesting, four instructional units correlating language skills development and science process skills and concepts were implemented. After a period of nine weeks of instruction, students were post-tested using the same instruments.

EVALUATION DESIGN

Objective Number One

By February 7, 1977, the researcher had completed instructional plans and materials to be used in correlation with S-APA science materials for the teaching of four language-science units.

Implementation. The researcher obtained S-APA modules containing some of the materials needed to carry out unit activities. Teachers' guides were also obtained for use with the following units:

1. Observing--Color, Shape, Texture, and Size
2. Classifying--Solids, Liquids, and Gasses
3. Measuring--Seeds and Seed Germination
4. Communicating--Stages in Life Cycles

Additional materials in Spanish and English used to supplement the program were ordered and collected. Existing learning centers were expanded and modified to reinforce basic concepts and extend insights of more able learners.

Dual language lessons were developed to reinforce previously presented concepts and to reinforce use of the target or second language in contexts already familiar to students. Visual materials and equipment were collected and developed for use during the units. Cooperative games and activities were devised which would emphasize discussion and mutual help as well as unit skills and concepts.

Evaluation. A sample of plans used during the four language-science units is included in the appendix.

Objective Number Two

By February 7, 1977, the researcher had selected and developed evaluation instruments to be used to assess progress in language skills and science concepts. Students were evaluated on their progress in the language by which they learned best, whether English or Spanish.

Implementation. It was determined that the CTBS Language section was a standardized instrument which could be used with limited validity to evaluate progress in written language skills of those students who read English. Criterion referenced tests were developed to give a more valid measure of students' achievement. The Describe An Animal test was designed to assess language expression. A rating scale for written language was developed. It was used to evaluate written language on the Describe An Animal test and on biweekly written assignments. The Picture-Concept test evaluated understanding of science concepts and processes. In addition, an anecdotal record form was developed to be used in conjunction with an oral language rating scale for evaluation of oral language skills. All researcher prepared evaluative instruments were field tested to determine their validity for use with the target population. Field testing of criterion referenced tests was conducted with selected members of a third

bilingual second grade class at Sunnyslope School. Anecdotal record forms and the oral and written language rating scales were field tested with the researcher's class before implementation began. Botel's Syntactic Complexity Formula¹ was used as a guide in developing the oral language rating scale.

Evaluation. A copy of the criterion referenced tests and the anecdotal record form for evaluation of oral language are included in the appendix. Table 3.2 lists the evaluative instruments used in this project and the number of students evaluated in English and in Spanish.

Objective Number Three

Between January 10 and March 28, the researcher designed and implemented a program of training for the aides involved in the project.

¹Morton Botel, John Dawkins, and Alvin Granowsky, "A Formula for Measuring Syntactic Complexity," Elementary English, 49, pp. 513-516.

Table 3.2
 Summary of Evaluative Instruments,
 Language Utilized, and
 Number of Students

Evaluative Instrument	Language	Students in	
		Treatment	Comparison
CTBS Language test	English	24	18
	Spanish	0	0
Describe An Animal written responses	English	19	18
	Spanish	5	5
oral responses	English	0	0
	Spanish	5	5
Picture-Concept test	English	19	15
	Spanish	10	13
Anecdotal record of oral responses	English	19	0*
	Spanish	5	0
	English/ Spanish	5	0
Biweekly written assignments	English	19	0
	Spanish	5	0

* Implemented with treatment group only as part of unit activities.

Implementation. Instructional plans were developed for use by aides working at learning centers and with small groups. Communication was maintained with the aids regarding their questions, inservice needs, observations, and suggestions. A series of short meetings provided inservice on the following topics:

1. Assisting with administration of pre- and post-tests.
2. Conducting oral assessments using anecdotal record forms and oral language rating scale.
3. Use of "word collection" cards to develop vocabulary.
4. Assisting students at learning centers and other small group activities.

Evaluation. A sample copy of plans developed for use by aides is included in the appendix.

Objective Number Four

From February 22, 1977 through April 29, 1977, four instructional units correlating language with science were implemented in the researcher's second grade bilingual classroom.

Implementation. Each day's class included a brief dual language review lesson. Students then worked in learning centers or in small groups discussing and writing about their science activities. They also read experience

charts, and tested each other on their "word collection" cards. Students listened to stories, poems, and songs in both languages which related to the units. Art projects focused on unit topics. Oral language was evaluated using the oral language assessment scale developed by the researcher, and recorded each week on anecdotal record forms. These anecdotal records also provided a basis for evaluation of program effectiveness and modification. A sample written assignment was collected biweekly, during the second week of each unit. After oral discussion of concepts learned during the unit, students were asked to write all they could about what they had learned. Assignments were evaluated using the written language assessment scale developed by the researcher.

Evaluation. Students in the treatment group were evaluated on oral language each week except the final week of review. A biweekly sample of each student's written work was also evaluated.

Figure 1 shows mean scores of groups of students on oral expression measured by using the oral language rating scale and recorded on weekly anecdotal records. Students were grouped by language proficiency. All groups gained in mean scores during the nine week project implementation.

Figure 1
Mean Scores of Treatment Group
on Weekly Oral Language
Assignments

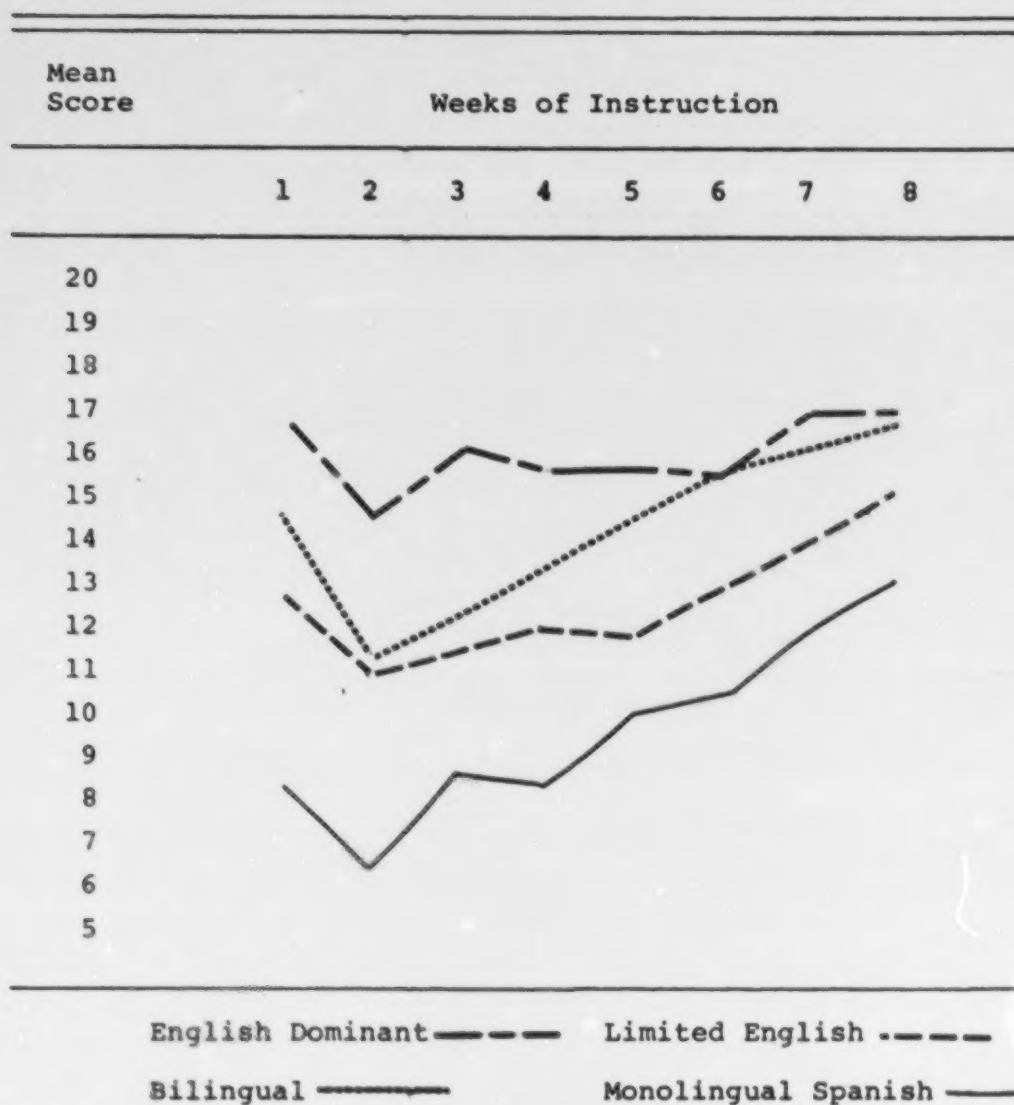


Table 3.3 shows means scores and T-values for oral language assessments recorded during the first unit and the fourth unit of implementation. As shown, the average final scores were higher than the first unit scores ($P < .01$).

Table 3.3

Means and T-Values for Oral Language Assessments
On First and Fourth Units of
Language-Science

Unit	Means	Standard Deviation	T-Value	Proba- bility
1	14.429	2.727	3.322*	.01
4	16.821	2.568		

* $P < .01$.

Table 3.4 shows significant gains in mean rank scores on biweekly written assignments completed by students in the treatment group. Students were rated on the number of concepts expressed, and on skill in mechanics of written expression. The Friedman two-way Analysis of Variance by Ranks was used to determine significance of the gains.

Table 3.4

Results of Friedman Two-Way Anova Comparing
Biweekly Written Assignments
for the Treatment Group

Assignment (concepts)	Mean Rank of Scores	Chi- Square	df	Proba- bility
1	2.23	22.190	3	0.000 *
2	1.88			
3	2.43			
4	3.41			
Assignment (Mechanics)	Mean Rank of Scores	Chi- Square	df	Proba- bility
1	1.45	47.741	3	0.000
2	2.21			
3	2.60			
4	3.74			

*Level of significance is $P < .01$

Objective Number Five

By May 9, 1977, the researcher determined whether language skills of second grade students in her bilingual class have improved during correlation of language and science instruction.

Implementation Activities. To evaluate the improvement of language skills of second grade bilingual students, the following activities were conducted on February 17 and 18, 1977 and on May 5 and 6, 1977 as pre- and post-tests.

1. CTBS Language test, including Mechanics of Expression, Spelling, and Language Mechanics was administered to treatment and comparison groups.

2. Describe An Animal test was administered to treatment and comparison groups. On this test, students were asked to describe an animal which was brought into the classroom. Separate scores were assigned for concepts and mechanics of written expression. Students who were unable to write were tested orally and assigned only a concept score. They were not included in calculation of scores in mechanics.

Evaluation. Table 3.5 shows significant mean gains made by the treatment group in all four areas of the CTBS Language test. The comparison group also made significant mean gains in three areas, but not in the language expression section.

The T-Test was used for calculations of these figures.

Table 3.5

Means and T-Values for Comparisons Between
Treatment and Comparison Group Scores
CTBS Language Test

Section	Means	Standard Deviations	T-Value	Proba- bility
Expression				
Treatment	3.41	3.69	4.43	0.000*
Comparison	0.52	2.91	0.75	0.465
Spelling				
Treatment	4.12	5.62	3.60	0.002*
Comparison	3.11	4.34	2.96	0.009
Mechanics				
Treatment	5.91	4.71	6.14	0.000*
Comparison	2.94	3.32	3.65	0.002*
Total Language				
Treatment	12.91	9.46	6.68	0.000*
Comparison	7.47	8.45	3.55	0.003*

* $P < .01$

On the criterion referenced Describe An Animal test, students were rated on the number of concepts they expressed and also rated on their mechanics of written expression, including Spelling, Punctuation and Capitalization, and Grammar. This test was developed to provide a more valid measure of achievement in written expression than could be obtained using the CTBS Language test.

Table 3.6 shows significant gains made by the treatment group on the Describe An Animal test in both concepts and Mechanics, ($P < .01$). The Wilcoxon Matched Pairs Signed Ranks test was used to calculate the level of significance. The Wilcoxon test was used in this instance because the emphasis is upon comparison of pre- and post-tests for each group individually.

Group 1, the treatment group, showed a higher mean of positive ranks on the Concept score, (13.77 to 8.91). Group 1 also showed a higher mean of positive ranks on the Mechanics score, (14.00 to 13.15).

Table 3.6
Results of Wilcoxon Matched-Pairs
Signed-Ranks Tests Comparing
Describe An Animal Scores

Section	Mean of -Ranks	Mean of +Ranks	Z	Proba- bility
Concepts				
Treatment	9.90	13.77	-3.040	0.002*
Comparison	12.44	8.91	-0.261	0.794
Mechanics				
Treatment	0.00	14.00	-4.541	0.000
Comparison	9.11	13.15	-1.445	0.149

* $P < .01$

Objective Number Six

By May 9, 1977, the researcher determined whether understanding of selected science concepts and processes by second grade students in her bilingual class had improved through correlation of language and process science instruction.

Implementation Activities. To evaluate the improvement of science concepts and processes, both treatment and comparison groups were tested using the science Picture-Concept test as pre- and post evaluative instrument.

Evaluation. Pre- and post test scores showed significant gains on scores of post-test over pretest for both treatment and control group. Both showed a probability of 0.000.

Table 3.7 shows the results of Wilcoxon Matched Pairs-Signed Ranks Tests comparing pretest and post-test science scores for treatment and comparison groups.

Table 3.7

Results of Wilcoxon Matched-Pairs
Signed-Ranks Tests Comparing
Picture-Concept Test Scores

Group	Mean of -Ranks	Mean of +Ranks	Z	Probability
Treatment	0.00	15.00	-4.703	0.000*
Comparison	6.83	15.42	4.156	0.000

* $P < .01$

SUMMARY

Through this project, a series of instructional units correlating language and science in a bilingual classroom was developed. The researcher used a discovery science program to develop understanding of vocabulary and other oral and written language skills. Progress of students in the treatment group was compared with that of students in a similar bilingual second grade class at the

same school. The comparison class was taught language and science separately in a traditional manner. The comparison class also had one Title VII aide and two Migrant Program aides to assist with language development. Both classes were tested on language ability using the CTBS Language test and a researcher developed criterion referenced instrument, the Describe An Animal test. Both classes also were tested on science concepts using a researcher developed instrument, the Picture-Concept test. In addition, the treatment group was evaluated on their oral and written work during implementation of the four language-science units.

On the Picture-Concepts test, both treatment and comparison groups made statistically significant progress on mean pre- and post-test scores.

On the CTBS Language test, the treatment group made significant mean gains in all three areas, Expression, Spelling, and Mechanics. The comparison group also made significant gains in two areas, but not in Expression.

On the Describe An Animal test of written language, the treatment group made significantly more progress than the comparison group.

Significant gains were also made by the treatment group on weekly written assignments.

Chapter 4

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

This chapter presents a summary of the findings, implications, and recommendations of the study.

CONCLUSIONS

The purpose of this project was to develop a series of instructional units correlating language and science instruction in a bilingual classroom. Each unit was designed to include language development activities such as vocabulary building, sentence writing, and spelling in the students' dominant language, English or Spanish. The units also included science process skills of observing, classifying, measuring, and communicating.

The researcher used the high interest which discovery science can spark in children to develop cognitive bases for understanding, to encourage oral language practice, to develop vocabulary and to provide the basis for practice in written expression.

Assessment of language development was carried out by administering pre- and post-tests to students in the treatment and comparison groups. The treatment group made significant gains over their pretest scores on all three areas of the CTBS Language section. The comparison group also made significant gains in Spelling and Mechanics, but not in Expression. While the CTBS is not intended to

measure growth over a short period of time such as the nine weeks involved in this project, the results give an indication of students' ability to deal with written English. There is a definite indication that the language-science program may have had a positive effect on language development.

On the Describe An Animal test, students were rated on the number of concepts they were able to express, and also rated on their mechanics of written expression, including spelling, punctuation and capitalization, and grammar. Significant mean gains were made by the treatment group over the comparison group on both concepts and mechanics. The researcher feels that this test was the most significant indicator of student progress during the project.

In addition to the above tests, biweekly written assignments of the treatment group were rated on concepts and mechanics using the same scale as had been used for the Describe An Animal test. Significant improvement was made by students on these assignments. This supports the results of the formal tests.

Weekly anecdotal records were kept on the oral language of each student. For this activity, students were grouped with other students of similar language ability; monolingual Spanish, limited English, Bilingual, and English dominant. Weekly mean scores for each group

was calculated and compared. All scores showed a significant gain during the period of implementation. Greatest gain was made by the monolingual Spanish group. This gain may be explained by the fact that this was the first year these children were regularly attending school. They were rapidly learning new skills. Their enthusiasm could also have been a factor in their growth.

Assessment of progress in science concepts was carried out by administering pre- and post Picture-Concepts tests to students in the treatment and comparison groups. The students in both treatment and comparison groups scored significantly higher on the post-test.

The presence of aides during the hour of project implementation was a definite advantage. The students had such diverse needs. Five students were monolingual Spanish, five used limited English, and the migrant status of both these groups had severely limited their school attendance and academic progress. Other students in the class were working substantially below grade level. It is understood that assistance of this kind would not be available in the average classroom. The researcher noted that aides' time was used much more effectively during project implementation. Earlier in the year the class had, at times, seemed "fractured" because of many small groups, each working on different tasks. A unity of purpose was noted by aides and researcher during the implementation. This may have

been because all students were studying the same topic and much intra-group discussion occurred. Work at the centers also resulted in mixing of groups while still following Migrant Program guidelines which specify certain students only may be assisted by Migrant aides.

Student reaction to the language-science units was enthusiastic. They enjoyed working with the science materials. They enjoyed making their "word collections" and soon noted that words often sound similar in English and Spanish. Students began to ask for both words (tri-angulo-triangle, solido-solid, planta-plant) to be printed on their cards. Systematic presentation of material in dual language lessons stimulated much more participation and experimentation on their target language by both English as a Second Language (ESL) students and Spanish as a Second Language (SSL) students. The researcher observed that the most difficult part of the implementation was management of the centers in a way that would allow the adults to circulate, assist, guide, and note student comments for later inclusion on experience charts.

The S-APA program had been chosen for its sequential and relatively structured activities which, it was felt, would lend themselves to a formal study. S-APA had been used successfully in a number of previous language-science studies. In use, the S-APA module guides contained a clear and effective statement of unit procedures. Delays

were experienced in obtaining even teachers' guides through Ginn and Company. As a result, some necessary S-APA materials and guides were borrowed from Hall School in Watsonville. S-APA modules do not contain numerous essential materials, which had to be collected and produced. The above mentioned drawbacks would have to be weighed against the quality of the S-APA program design by persons considering its use.¹

IMPLICATIONS AND RECOMMENDATIONS

The researcher believes that this project has significance for language development and science instruction in both bilingual and traditional programs at the primary level. The great concern of the school is to develop a cognitive base upon which effective language skills can be developed, and thus to assist students to utilize their capabilities in preparation for a satisfying and productive life.

¹In an interview with Dr. Larry Bishop, Professor of Elementary Education at the University of San Francisco and developer of ECE workshops on Science and Language, Dr. Bishop expressed the opinion that S-APA's qualities are also somewhat offset by being difficult for teachers untrained in science to use.

It is recommended that a means of assessing progress in acquisition of science concepts and ability to use science processes be developed. The Picture-Concept test used in this project should be expanded and modified to increase validity and usefulness for this purpose.

Development of inservice programs by members of Sunnyslope School staff is encouraged, and is presently underway in the areas of manipulative material and gross motor development. The researcher will work with other staff members to present an inservice program on language development through science. It is recommended that a specialist in the area of language and concept development through science such as Dr. Larry Bishop of the University of San Francisco or Del Alberti of the Nueva Day School and Learning Center be invited to conduct a district-wide workshop.

It is recommended that a pilot science kit be developed and classroom tested for later expansion and use. A science committee should survey what is taught in primary grades and obtain materials and equipment teachers need. In addition, discovery science teachers' guides and handbooks should be made available in connection with the above mentioned workshops so that instructional methods mentioned in the guides can be best utilized to combine language and science instruction.

The researcher intends to expand and continue implementation of the language-science units tested in this project. It is felt that student interest and enthusiasm generated and the unifying effect of the curriculum and methods are in itself bases for continuing the program.

APPENDIX A

SCIENCE

PICTURE-CONCEPT TEST

General Instructions

1. Place cardboard dividers between desks.
2. Make sure each student has the following:
 - A. Pencil with eraser
 - B. Metric ruler
 - C. Two lima beans, one large and one small.

Directions for
Administering

Look at the first page. Please write your first and last name at the top.

1. Now look at the box at the top of the page. (Demonstrate using sample copy.) Draw a big circle in the box. (Repeat once.)

2. Look at the next box. Draw a little square in the box.

3. Look at the next box. Draw a big triangle in the box.

4. Look at the last box. Draw a big rectangle in the box. Now turn the page.

5. In the first row of pictures you see a tea-kettle that is steaming, a bell, and a glass of milk. Mark the picture that shows a gas.

6. In the next row, you see water running, a boy with steaming breath on a cold day, and a cherry. Mark the picture that shows a liquid.

7. In the next row you see an ice cube, a jar with water and fish, and some mountains, a tree, and clouds. Mark the picture that shows a gas.

8. In the last row you see a balloon, a bottle of soda, and some carrots. Mark the picture that shows a solid. Now turn the page.

9. At the top of the page you see two sentences. They say The small bean is __centimeters long. and The big bean is __centimeters long. Measure your beans and write how long they are.

10. Next you see some pictures of bean plants. Measure each plant. Use the graph to show how tall each plant is. Now turn the page.

11. In the first row of pictures you see a corn plant, a corn seed, and a corn sprout. Write a 1 beside the picture of the youngest item, a 2 beside the next youngest item, and a 3 beside the oldest item.

12. In the next row you see a frog, some frog eggs, and a tadpole or pollywog. Write a 1 beside the picture of the youngest item, a 2 beside the next youngest, and a 3 beside the oldest.

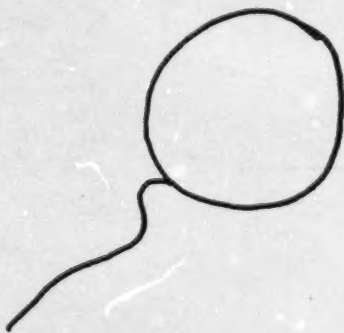
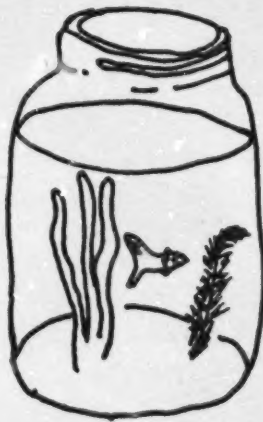
13. In the next row you see an egg, a chicken, and baby chick. Write a 1 beside the youngest, a 2 beside the next youngest, and a 3 beside the oldest.

14. In the last row you see a caterpillar, a butterfly, a chrysalis, and an egg. Write a 1 beside the picture of the youngest, a 2 beside the next youngest, and a 3 beside the next, and a 4 beside the oldest.

Scoring

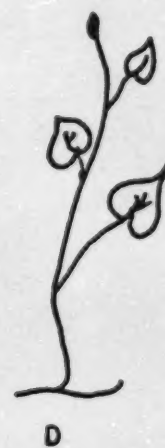
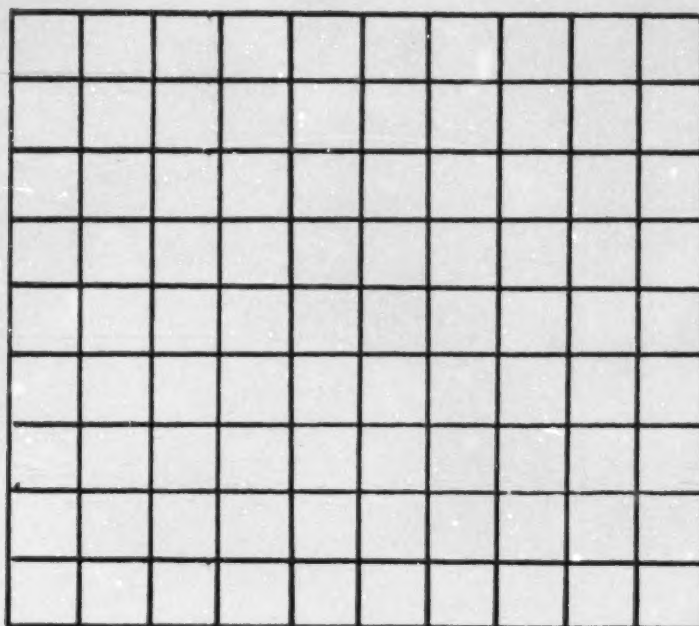
One point is given per correct answer. On page 3, student must write numbers of centimeters and letters indicating plants on the vertical and horizontal axes in order to receive credit.

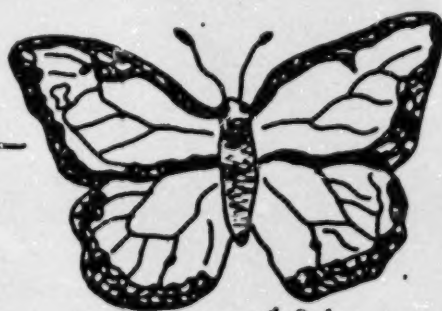
This test may be administered in English or Spanish.



THE SMALL BEAN IS ____ CENTIMETERS LONG.

THE LARGE BEAN IS ____ CENTIMETERS LONG.





DESCRIBE AN ANIMAL
TEST OF WRITTEN LANGUAGE

General Instructions

1. Place cardboard dividers between desks.
2. Make sure each student has a pencil with an eraser, crayons, and a sheet of large ruled newsprint with space for a picture.

Directions for
Administering

1. Bring the animal to be described into the room for the first time just before the test.
2. Stand where all can see, and hold the animal. Encourage discussion, but give no information nor comment on the students' statements. Only the following phrases may be used.
3. What kind of animal is this?
4. Can anyone tell us something they see about this animal?
5. What is it doing? How does it move?
6. If possible, let the animal move freely in the room for a minute or so.
7. After five minutes of discussion, say Now we are going to write about the animal you saw. Write everything you can remember. Do your best work. Remember to use capital letters and periods where they are needed.

8. This test may be administered in English or Spanish. Students may write in either language. Students who cannot write may dictate their descriptions to an examiner.

Scoring

1. Concepts

Students score one point for each idea expressed. For example, it has long pink ears scores three points. Repeated concepts do not count.

2. Mechanics

In order not to penalize the student who writes more (increasing chance for errors), each item in this section is rated on a scale from one to five points. Students are rated on Spelling, Punctuation and Capitalization, and Grammar.

Score	Competency
1	Nearly unable to do task
2	Below average
3	Average
4	Above average
5	Excellent

APPENDIX B

ANECDOTAL RECORD

ORAL LANGUAGE

Observer _____

Date _____

Name	Complete Sentence	Understands Concept	Syntax	Enjoy- ment

Notes:Oral Language
Rating Scale

Score

1
2
3
4
5

Competency

Nearly unable to do task
 Below average
 Average
 Above average
 Excellent

Written Language Rating Scale
for Describe An Animal Test
and Biweekly Assignments

Value	Description
1	Done with extreme difficulty.
2	Done with considerable difficulty. Many errors.
3	Average achievement
4	Above average achievement. Few errors. Limited response.
5	Complete, varied response using excellent grammar.

The above scale was used to evaluate written language on the Describe An Animal test and on all written assignments.

In addition, each test or assignment was evaluated on the number of concepts expressed. Each correct concept scored one point.

APPENDIX C

GENERAL PLANS

SCIENCE-LANGUAGE UNIT

OBSERVING: COLOR, SHAPE, TEXTURE, AND SIZE¹Objectives

At the end of this unit each child should be able to:

1. Identify an object on the basis of color, shape, texture, and size.
2. Name two or more characteristics of an object using a complete sentence.
3. Construct a grouping of objects on the basis of color, shape, texture, and size.
4. Write observations about characteristics of one object or group of shapes.²

Additional Exposure

(This differs from objectives in that mastery is not expected at the end of this unit).

1. Monolingual Spanish students will review skills taught during English as a Second Language period

¹Based on S-APA level B, Module 3.

²Students who have attended school less than a year due to migrant status will dictate their observations. They will practice reading and copying this dictation.

(ESL) including words for colors, shapes, sizes, and sentences, including: I have a..., She or he has a..., May I have a..., Do you have a..., and No, I don't have a....

2. Limited English speaking students will also review the above terms. Any difficulty will be noted so that remedial work may be given if necessary to develop competency.

3. English dominant students will review skills taught during Spanish as a Second Language period (SSL) (Same as item 1, above except in Spanish).

4. Bilingual students will review the above terms in both languages. Any difficulty will be noted so that remedial work may be given if necessary to develop competency.

Daily Schedule

1. Spanish section of dual language lesson, five minute review and extension of concepts.
2. Learning centers, twenty-five minutes.
3. Small group activity, 20 minutes.
4. English section of dual language lesson, five minute review and extension of concepts usually done after lunch.

Learning Centers

1. El Rodeo Stand-up cards with colored circles, squares, triangles, and rectangles, some made of sandpaper

to give rough texture. These cards also have a small sticker of a bronco or toro. Activity: Construct a grouping of objects on the basis of color, shape, texture or size by circling the group with a lazo made of light rope. Then title the group by placing a cowboy card with a title, such as ALL ROUGH TRIANGLES, in the circle. (Cards have cowboy stickers.)

2. Writing Station Students draw a shape and describe it in writing using their "word collections" for help with spelling. Students then get a friend to read the description. The friend also helps proofread it. When descriptions are finished they may be typed. (Since everyone wants to use the typewriter, priority goes to students with excellent work and/or very great improvement).

3. Parquetry Make figures using task cards for direction. Then trace the figures and color. (This station provides extension for students who already know the four basic shapes and want to try some hard ones like octogan and trapazoid. It also reviews colors and provides hand-eye coordination.

4. Listening Center Use one of three tapes; one tape of related songs with word sheets in English and Spanish, and one of related stories including (Alma Flor Ada's El Cuadrito Triste and Walt Disney's The Square World). The third tape gives directions in English and Spanish. For example, Make three green squares. Haz un

circulo grande. Students work with crayons and paper on this tape.

5. Easel The rule for this center is, be able to tell about your picture. What does it show; what shapes did you use? Did you mix any colors to get new colors? What were they?

6. Cuisenaire Center Use task cards to compare length and to form designs. Use centimeter graph paper and crayons to show the designs you made.

7. Collage Center Use pre-cut paper to form pictures. Describe the shapes you use.

Use of the Centers

Students are assigned to centers based on their request. They must finish the activity at the center before starting another. The first ten minutes at centers requires help from teacher and aides to get started.

(Many of the center activities are familiar because similar centers have been used previously). After getting started, adults circulate, assist, note student comments for use on experience charts, and make information assessment. Simple directions are printed on cards in English and Spanish. Students start center by reading card aloud. Students help each other with directions.

Rationale for This Unit

The S-APA unit on Color, Shape, Texture, and Size is scheduled for presentation early in first grade. However, the S-APA guide recommends review when starting to use the program. During midterm evaluation of student progress, it was noted that many students were still confusing the concepts, square, rectangle, triangle, rough and hard, smooth and soft, large and small. Reading and writing color words was difficult for many students.

DAILY PLANS

OBSERVING: COLOR, SHAPE, TEXTURE, AND SIZE

Monday, 2/21/77 Holiday

Tuesday, 2/22/77

1. Dual language lesson, Spanish section. Display cutout shapes. Ask who wishes to come up and tell about shapes or compare two shapes. Encourage Spanish. Accept English. The presenter always speaks Spanish. (Mrs. Berta Garcia, Title VII Aide generally will present this lesson, however the researcher also will do so at times.)
2. Centers. Students will be assigned to centers they chose the previous week. Stop at 10:10 sharp and clean up. (Mrs. Dolores Valadez and Mrs. Alice Martin, Migrant Program Aides circulate and work with their assigned students. Researcher assists as needed.)

3. Small group session. Students discuss what they did in centers. Add new words to "word collections" and test a partner on his or her words. Read chart on shape, color, texture, and size. Mrs. Garcia works with Bilingual students, Mrs. Martin works with limited English students, Mrs. Valadez works with monolingual Spanish students, and the researcher works with English dominant students. The researcher will often trade groups for short periods in order to work with all students.

4. Dual language lesson, English. Guessing game. For example, "It's small, red, and has three sides. Who can show it to us and tell what it is?" (The researcher generally presents this lesson. Time: after lunch.)

Wednesday, 2/23/77

1. Dual language lesson. Same as Tuesday.
2. Centers. Same as Tuesday.
3. Small group session. Read experience charts based on student observations. First, whole group reads in chorus. Then briefly take turns. Ask questions like: "Can you find the sentence that tells, what colors ____ mixed to get green paint?" Have student come up and "frame" the sentence with hands while reading it. Ask for example, "Can you find one word that tells, what shape the king in The Square World wanted everyone to be?" Keep the pace fast on this activity. Students may ask for words to add to "word collections" and test a friend on his/her

cards.

4. Dual language lesson, English. "Who can find some of the shapes we have been studying in the furniture of this room?" (For example, there are rectangular cupboards, a circular clock).

Thursday, 2/24/77

1. Dual language lesson. Ask students to show something they have been doing in centers.

2. Centers. Most students will be ready to change to a new center. Check off completed work.

3. Small group session. Same as Wednesday.

4. Dual language lesson, English. Other students show or tell about their work in centers. Song: Hap Palmer's "This is a Song About Colors".

Friday, 2/25/77

Small Group sessions for full period.

1. Oral language assessment, using anecdotal record form.

2. Practice writing assignment. Students describe a shape or group of shapes. Ask a friend to read the description and see if the shape can then be found, using written description.

Monday, 2/28/77

1. Dual language lesson, Spanish section. Display cutout shapes for flannelboard. Ask who would like

to put all shapes that are the same on the flannelboard. In addition to such groupings as all triangles or all squares, encourage a grouping of all rough rectangles or all yellow squares. Ask, for example, "Why doesn't this (circle) fit into the group?"

2. Centers. Continue at the same center as on Thursday. Half of class goes to library. After twenty minutes, students at centers will go to the library, and the first group will work at centers.

3. Dual language lesson, English section. "Reach into a 'feely bag' and describe the shape you feel." Change the game slightly and involve other class members. They ask questions about the shape in the bag. For example, "How many sides does it have?" "Is it rough?"

Tuesday, 3/1/77

1. Dual language lesson, Spanish section. Play 'Feely Bag' game.

2. Centers. Change centers, and mix students at centers. Each center will have one monolingual Spanish student and one of the monolingual English students, one limited English student, and one or two bilingual students.

3. Small group session. Students discuss what they did in centers. Add new words to "word collections." Some students practice writing new words on chalkboard. Others test a partner on his or her words, while teacher or aide checks some students on reading words relating to color, shape, and texture using flash cards. Note any

words missed on a checksheet of skills to master. Read chart, first as a group, then individuals. (See 2/23/77.)

4. Dual language lesson, English section. Ask students to arrange shapes on flannelboard as done in Spanish. (See 2/28/77.)

5. Story Time. Students may choose the story they would like to hear, in Spanish or English. (We note that usually one or two monolingual children ask to hear a story in their target language.) Two story circles are formed with teacher and aide reading.

A Pair of Red Clogs, by Matsuno Masako

Formas, From Mi Primera Biblioteca Basica

Wednesday, 3/2/77

1. Dual language lesson, Spanish Section. Ask all students to quickly find something which has a shape we have been studying to bring to the circle. Then tell what it is, and what shape it has. Include color and texture if possible. For example, "Tengo un lapiz. Es un circulo." And show the blunt end of the pencil that is circular. Phrases such as these have been learned by most monolingual students in SSL class.

2. Centers. Add the following centers:

Gadget Printing: Using a collection of gadgets including nail heads, unifix cubes, jar lids, etc. print shapes with tempera on colored paper.

Stencil Art: Use tagboard stencils of shapes and shape

and color words to make a design. Ask a friend to match the words and shapes on the paper.

Pegboard: Make Shapes using the pegboard and rubber bands.

Can some smaller shapes fit inside a larger shape? Can you make a circle on the pegboard? Why or why not?

Challenge a friend to make a shape that is a certain number of pegs each way. Write down your directions and see if your friend can follow them. For example, write:

Make a rectangle three pegs long and five pegs wide.

Haz Un Libro: After listening to the tape, El Cuadrito

Triste, use the cut paper at this station to make a book. Write a story about a shape. Remember, a story needs a beginning, a middle, and an end. The teacher will work at this center with five more mature students. They will use the story they heard as a model to get ideas for a plot. Books will have light cardboard covers with cloth glued on the outside. All materials will be available at the center, precut.

3. Small group session. Students discuss what they are doing at centers, and show anything they have made. Read Chart Two on student's comments made at centers. Play guessing game in which one student hides eyes while another student selects a shape. The first student asks, for example, "is it round?"

4. Gross Motor Lab. Each Wednesday students participate in activities to develop control of large muscles. [A month previously, three quarters of the stu-

dents had had difficulty with the oral requirement of the station using shapes. Directions were: "When the teacher points to three shapes, tell what you are going to do, then do it." For example, say: "I will crawl through the triangle." (Made of wood and is held erect on a stand.) This time no one made any errors.]

5. Dual language lesson, English section. This activity was omitted. All students understood the concepts.

Thursday, 3/3/77

1. Dual language lesson. Spanish Section.

Students evaluate some of their art projects in Spanish. Complete sentences are encouraged. SSL students may use just words or phrases.

2. Finish work in centers.

3. Small group session. Brief reading of the charts. Then, to review concepts, students are asked to fold a sheet of scratch paper into eighths. Then they are given the following directions in English, except for the monolingual Spanish group:

- A) Make a large blue circle in the first box.
- B) Make a small yellow square in the second box.
- C) Write the word red with red crayon...

Continue, fitting the directions to the ability of the students. Then each child checks his or her own paper and makes any necessary corrections.

Friday, 3/4/77

Small group sessions for full period.

1. Oral language assessment, using anecdotal record form.
2. Writing assignment. Students describe the shapes, colors, textures and sizes used in one of their art projects. Collect these samples for rating.

SOME NOTES ON LESSON PLANS

Lesson plans included in the Appendix are essentially the same as used with the units. Additional explanation is included when necessary. Activities which were found to be unworkable are omitted and activities which were substituted are included.

Aides used duplicated copies of General and Daily Plans. They also utilized the S-APA module guide and related units in El mundo de la ciencia, Levels 1 and 2, Ediciones Anaya and Concepts in Science, a state textbook.

BIBLIOGRAPHY

A. BOOKS

- Alberti, Del and Mary Laycock. Correlation of Science and Math. Hillsborough, California: Nueva Day Learning Center, 1976.
- Angel, Frank. "Social Class or Culture: A Fundamental Issue In the Education of Culturally Different Students," in Bernard Spolsky, ed. The Language Education of Minority Children. Rowley, Massachusetts: Newbury House, 1972.
- Ashton-Warner, Sylvia. Teacher. New York: Simon and Schuster, 1963.
- Bernstein, Basil. "Social Structure, Language and Learning." From Educational Research, 1961, in A. Harry Passow and others. Education of the Disadvantaged. New York: Holt, Rinehart and Winston, 1967.
- Bloom, Benjamin S. Stability and Change in Human Characteristics. New York: John Wiley and Sons, 1965.
- _____, and others. Taxonomy of Educational Objectives, Handbook 1, Cognitive Domain. New York: Longmans, 1956.
- Boyle, D. G. A Student's Guide to Piaget. Oxford: Pergamon, 1969.
- Bruner, Jerome S. Process of Education. Cambridge: Harvard University Press, 1960.
- _____. Toward A Theory of Education. Cambridge: Belknap Press, Harvard University Press, 1967.
- Campbell, J.J. "Using the Language Arts Naturally: the Story of a School Camp." Elementary School Journal. 76, (May 1976).
- Carswell, Evelyn M. and Darrell L. Roubinek. Open Sesame (A Primer in Open Education). Pacific Palisades, California: Goodyear Publishing, 1974.

Coleman, James S., and others. Equality of Educational Opportunity. Washington, D.C.: U.S. Government Printing Office, 1966.

Cremin, Lawrence A. The Transformation of the School. New York: Alfred A. Knopf, 1961.

_____. The Genius of American Education. New York: Basic Books, 1976.

Dewey, John. Democracy and Education. New York: McMillain, 1916.

Dixon, Carol N. "Teaching Strategies for the Mexican American Child." Reading Teacher. November, 1976.

Ekstein, Rudolf, and others, eds. From Learning For Love To Love of Learning, Essays on Psychoanalysis and Education. New York: McMillain, 1969.

Englemann, Siegfried. Preventing Failures in the Primary Grades. Chicago: Science Research Associates, 1969.

_____. Your Child Can Succeed. New York: Simon and Schuster, 1975.

Fishman, Joshua. Bilingual Education, an International Sociological Prospective. Rawley, Massachusetts: Newbury House, 1976.

Flannigan, John C. and others. Language Arts Behavioral Objectives. Palo Alto, California: Westinghouse Learning Corp., 1971.

Frost, Joe L. and Glenn R. Hawkes, eds. The Disadvantaged Child, Issues and Innovations. New York: Houghton Mifflin, 1966.

Gagné, Robert. The Conditions of Learning. New York: Holt, Rinehart and Winston, 1965.

_____. and Leslie J. Briggs. Principles of Instructional Design. New York: Holt, Rinehart and Winston, 1973.

Goodman, Paul. Compulsory Mis Education. New York: Horizon Press, 1964.

Herndon, James. The Way It Spozed To Be. New York: Simon and Schuster, 1968.

Hertzberg, Alvin and Edward F. Stone. Schools Are For Children. New York: Shocken Books, 1971.

Hoffmann, Banesh. The Tyranny of Testing. New York: Crowell-Collier, 1962.

Holt, John. How Children Fail. New York: Delta Books, 1967.

Hunt, J. McVicker. "How Children Develop Intellectually." from Children, May-June 1974, in The Disadvantaged Child, Issues and Innovations. Boston, Houghton Mifflin, 1966.

Isaacs, Nathan. A Brief Introduction to Piaget. New York, Agathon Press, 1961.

Jencks, Christopher. Inequality. New York: Basic Books, 1972.

King, Edmund J. Other Schools and Ours. London: Holt, Rinehart and Winston, 1963.

Koch, Kenneth. Wishes, Lies, and Dream, Teaching Children to Write Poetry. New York: Random House, 1970.

Kohl, Herbert. 36 Children. New York: New American Library, 1968.

_____. The Open Classroom, a Practical Guide To a New Way of Teaching. New York: Random House, 1970.

Lambert, Wallace E., and G. Richard Tucker. Bilingual Education of Children, the St. Lambert Experiment. Newbury House: Rowley, Massachusetts, 1972.

Lavater-Sloman, Mary. Pestalozzi, Die Geschichte Seines Lebens. Artemis-Verlag: Zürich, 1954.

Lewis, Oscar. La Vida. New York: Random House, 1966.

Modgil, Sohan. Piagetian Research, a Handbook of Recent Studies. NFER Publishing Co., 1973.

Montessori, Maria. The Montessori Method. Tran. by Anne G. George. New York: Frederick A. Stohr, 1912.

Orem, R. C. ed. Montessori for the Disadvantaged. New York: G.P. Putnam's Sons, 1967.

Passow, Harry A., Mirriam Goldberg, and Abraham Tannenbaum, eds. Education of the Disadvantaged. New York: Rinehart and Winston, 1967.

Piaget, Jean. A Child's Conception of the World. Tran. by Joan and Andrew Tomlinson, London: Routledge and Kegan, 1929.

_____. Science of Education and the Psychology of the Child. New York: Orion Press, 1970.

_____. To Understand Is To Invent, The Future of Education. Tran. by George-Ann Roberts, New York: Grossman Publishers, 1973.

Silber, Kate. Pestalozzi, The Man and His Work. Routledge and Kegan Paul: London, 1960.

Silberman, Charles E. Crisis in the Classroom. New York: Random House.

Waters, Barbara S. Science Can Be Elementary, Discovery Action Programs for K-3. New York: Citation Press, 1973.

White, Burton L., Jean Carrew Watts and others. Experience and Environment: Major Influences on the Development of Young Children. v. 1. Prentice-Hall: Englewood Cliffs, New Jersey, 1973.

B. DISSERTATIONS

Almy, Millie C. Children's Experiences Prior to First Grade and Success in Beginning Reading. Unpublished doctoral dissertation, Columbia University, Teachers College Press, 1949.

Anderson, Ronald Delaine. Children's Ability to Formulate Mental Models To Explain Their Observation of Natural Phenomena. Unpublished doctoral dissertation, graduate School, University of Wisconsin, Ann Arbor, Michigan: University Microfilms, Inc. 1964.

Holl, Katherine E. Children's Contributions in Science Discussions. Doctoral dissertation, Bureau of Publications, Teachers College, Columbia University, New York, 1947.

C. JOURNALS AND PERIODICALS

- Ada, Alma Flor and Maria del Pilar Olave. "Desarrollo Linguistico y vivencia cultural a traves de la literatura infantil." Journal of the National Association of Bilingual Education, 1:1, (May, 1976).
- Andersson, Theodore. "The Bilingual Child's Right To Read," Journal of the National Association for Bilingual Education. 1:1, (May, 1976).
- Ayers, Jerry B. and George Mason, "Differential Effects of Science-A Process Approach Upon Change of Metropolitan Reading Test Scores Among Kindergarten Children." Reading Teacher, 22, 1969.
- _____ and Mary N. Ayers, "Influence of S-APA On Kindergarten Children's Use of Logic in Problem Solving." School Science and Mathematics, 73, 1973.
- Barufaldi, James P. and Jennifer Wallenfels Swift. "Children Learning to Read Should Experience Science." Reading Teacher. 30:4 (January, 1977).
- Botel, Morton, John Dawkins and Alvin Granowsky. "A Syntactical Complexity Formula." Elementary English. v. 49.
- Castañeda, Alfredo and Tracy Gray. "Bicognitive Processes in Multicultural Education." In Educational Leadership. 82:3, December 1974.
- Cole, Michael and Jerome S. Bruner. "Cultural Differences and Inferences About Psychological Processes." American Psychologist, October 1971.
- Cornejo, R. J. "Reading in the Bilingual Classroom." Yearbook of the Claremont Reading Conference, v. 39, 1975.
- Esler, William K. and King Merritt, Jr. "Teaching Reading Through Science Experience Stories." School Science and Mathematics, v. 76 (March, 1976).
- Fishman, Joshuah. "Bilingualism, Intelligence and Language Learning." Modern Language Journal, 49, (April 1965).
- Gagné, Robert M. "The Acquisition of Knowledge." Psychological Review. v. 69, 1962.

- Gaines, Edythe. "Do We Owe Children Science As Part of the Basics?" Science Teacher, 43:28, May, 1976.
- Garcia, Ernest. "Chicano Cultural Diversity: Implications for CBTE". in Multicultural Education Through Competency-Based Teacher Education. William A. Hunter, ed. Washington, D.C.: American Association of Colleges for Teacher Education, 1974.
- Garcia, Ricardo. "Mexican Americans Learn Through Language Experience." Reading Teacher, 28:3 (December 1976).
- "Knowledge of Science Declines." Science News, v. 107, (March 29, 1977).
- Kolers, Paul A. "Reading and Talking Bilingually." Journal of Psychology, 75:3, (September, 1966).
- Lawson, Anton D. and others. "Levels of Intellectual Development and Reading Ability in Disadvantaged Students and the Teaching of Science." Science Education, 59:1, 1975.
- Lisonbee, Lorenzo. "Teaching Science To the Disadvantaged Pupil." A paper presented at the Southwest and Rocky Mountain Regional Meeting of the American Association for the Advancement of Science, April 29, 1963, from The Science Teacher, October, 1963.
- Livio, N. J. "Variations on a Theme: Frogs". Language Arts. 53 (February, 1976).
- Malkin, Samuel. "The Culturally Disadvantaged Child and Science". Science and Children. April, 1964.
- Mead, Margaret. "Why Our Schools are Failing to Teach." Redbook, August 1976.
- Neuman, Donald. "You Don't Have Time Not To Teach Science." Science and Children, 12:3, (November-December, 1974).
- Pride, J. W. The Deficit-Difference Controversy. A paper read to the Linguistic Society of the University of Leeds, February, 1973. Archivum Linguisticum, v. 5 1974.
- Reismann, Frank. "Overlooked Positives of Disadvantaged Students". Journal of Negro Education, Summer, 1965.

Rowe, Mary Budd. "Help is Denied Those Who Need."
Science and Children 12:6 (March 1975).

Silberman, Charles E. "The City and the Negro".
Fortune. March, 1962.

Stafford, Don G. and John W. Renner. "SCIS Helps First
Graders to Use Simple Logic in Problem Solving".
School Science and Mathematics. 71 (February, 1971).

Wasserman, Susan. "Raising English Language Proficiency
of Mexican American Children in the Primary Grades."
California English Journal, 12:2, (April 1970).

D. OTHER SOURCES

Central Advisory Council for Education for England. Children and Their Primary Schools. 2 Vols. London: Her Majesty's Stationery Office, 1967.

Gagné, Robert and Mary Lela Sherburne. "The Psychological Bases of Science--A Process Approach, American Association for the Advancement of Science Misc. Pub., 1965.

Jourdane, John R. "Bilingual Math Science Learning Center." U.S. Educational Resource Information Center, ERIC Document 051 716, September, 1970.

Juarez, John R. "Subordinate and Superordinate Science Process Skills: An Experiment in Science Education Using English and Spanish With Fifth Grade Children in Bilingual Schools". U.S. Educational Resource Information Center, ERIC Document ED 123 112.

Kessler, Carolyn. Acquisition of Syntax in Bilingual Children. Washington D.C. Georgetown University Press, 1971.

Quinn, Mary Ellen and Carolyn Kessler. "Relationship between Science Education and Language Development" Report presented to the annual meeting of the American Research Association, April 19-23, 1976, U.S. Educational Resource Information Center, ERIC Document 123 112.

Salven Los Niños, Title VII Project Proposal. Hollister Elementary School District: Hollister, California, 1976.

Science-A Process Approach, II Module Guides for Levels B and C. American Association for the Advancement of Science. Xerox 1974.

Saville-Troike. "From Melting-Pot to Salad Bowl, The Promise and Reality of Multicultural Education". A keynote speech for the New York ESL Bilingual Education Association Convention, Syracuse, New York, 1974.

Tremaine, Ruth V. Syntax and Piagetian Operational Thought A Developmental Study of Bilingual Children. Washington D.C.: Georgetown University Press.

United States Commission of Civil Rights Clearinghouse. A Better Chance to Learn: Bilingual/Bicultural Education, Publication 15, 1975.

